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TREASURY DEPARTMENT
Public Health and Marine-Hospital Service of the United States

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MARITIME QUARANTINE

BY

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INTRODUCTION.

The main object in the preparation of this pamphlet was to arrange certain facts concerning maritime quarantine practice in a compact form for convenient use.

The author has availed himself of material from many sources, notably from the various annual reports of the service and from articles written on quarantine and sanitary subjects by the Surveyor-General. Various text-books and monographs have also been consulted, and pertinent information extracted therefrom; but specific mention can not be made of all of the sources of information, which, on account of the length of time intervening between the preparation of the article and its publication, can not now be recalled to mind.

L. E. C.

FIG. 1.—SHOWING THE PROPER WAY OF CLIMBING A VESSEL S SIDE LADDER WHEN BOARDING FROM A LAUNCH.

MARITIME QUARANTINE.

By Assistant Surgeon-General Lela d E. Cofer.

THE TYPES OF VESSELS MET WITH IN MARITIME QUARANTINE PRACTICE.

The most important general classification of ocean carriers, from a practical quarantine standpoint, is that of modern vessels as opposed to those of the old type. The modern steam vessel is almost without exception large, with a general arrangement tending to the wide and distinct separation, by bulkheads and decks, of the three classes of passengers on the one hand and of the different departments of the ship's personnel on the other. Such vessels have high superstructures amidships, in which the first-cabin passengers always and the second-cabin passengers frequently live in a world apart from everyone else on board. The steerage passengers are usually quartered around the main freight hatches forward and aft below the spar deck, and the seamen, firemen, and messmen are quartered on the same deck, but in separate compartments amidships. The old type steam vessel, although carrying out our traditional ideas of what is nautical, is seldom large, and is devoid of arrangement tending to a wide and distinct separation of classes and departments. The decks sweep gracefully fore and aft, and the superstructure frequently affords direct communication with any or all parts of the ship. The quarters on such vessels are constructed with reference to the conservation of freight space, and the separation of classes on board is, from a quarantine standpoint, purely imaginary.

Ocean carriers are classified for quarantine purposes as follows:

First. Modern steam vessels.

Second. Old type steam iron vessels.

Third. Naval vessels and military transports.

Fourth. Steel sailing vessels and tramp steamers.

Fifth. Wooden vessels.

Modern steam vessels.—The modern large steam vessels are rapidly replacing those of the old type on the transoceanic routes, and there is no doubt, from a sanitary standpoint, they are far safer than the old type of vessels. The large steamers are so expensive to maintain

that their runs are quicker and their time in port much shortened, all of which has a bearing on the chances of their becoming infected with the intermediate hosts of certain quarantinable diseases. These vessels are equipped with all the modern appliances for ventilating and for the automatic flushing of latrines. Below the water line the hull is divided into compartments by water-tight bulkheads, which probably limit the migration of vermin. Even the loftiness of the hull affords some protection to the ingress of vermin.

Old type steam iron vessels.—The old type steam iron vessels present rather the reverse of the conditions enumerated above, and for this reason are classified separately in determining their probable status from a quarantine point of view.

Naval vessels and military transports.—Naval vessels and military transports, while they do at times become infected with, and are therefore capable of carrying, quarantinable disease, are comparatively safe for the reason that commercialism enters nowise into their conduct, and every officer on board is officially and morally the guardian of their sanitary integrity.

Steel sailing vessels and tramp steamers.—Steel sailing vessels and tramp steamers usually make long voyages, visit many countries, have the carrying of freight as their sole aim, and, in short, present the greatest hazard to the quarantine officer of any of the varieties of ocean carrier.

Wooden vessels.—Wooden vessels are placed in a class to themselves simply because once infected they present, on account of their construction, a great many obstacles to proper disinfection.

All signs point to the gradual substitution of steamers for sailing vessels all over the world, and it is predicted that this substitution will proceed more rapidly in the future than it has in the past. This fact has an important bearing upon the practice of maritime quarantine, for the reason that quarantine work in steamers presents far greater difficulties than in sailing vessels, steamers being more easily and more often infected than sailing vessels. The quarantine future therefore holds many reforms of procedure and judgment as the hazard of infection transmission increases with the change from sail to steam.

Maritime Quarantine Practice.

The boarding of vessels.

The boarding of vessels for the purpose of making the quarantine inspection is done by means of boarding steamers. Boarding steamers vary in character and size according to the amount of wind and rough weather likely to be encountered, the distance to be covered in reaching vessels, and the probable necessity of their being utilized

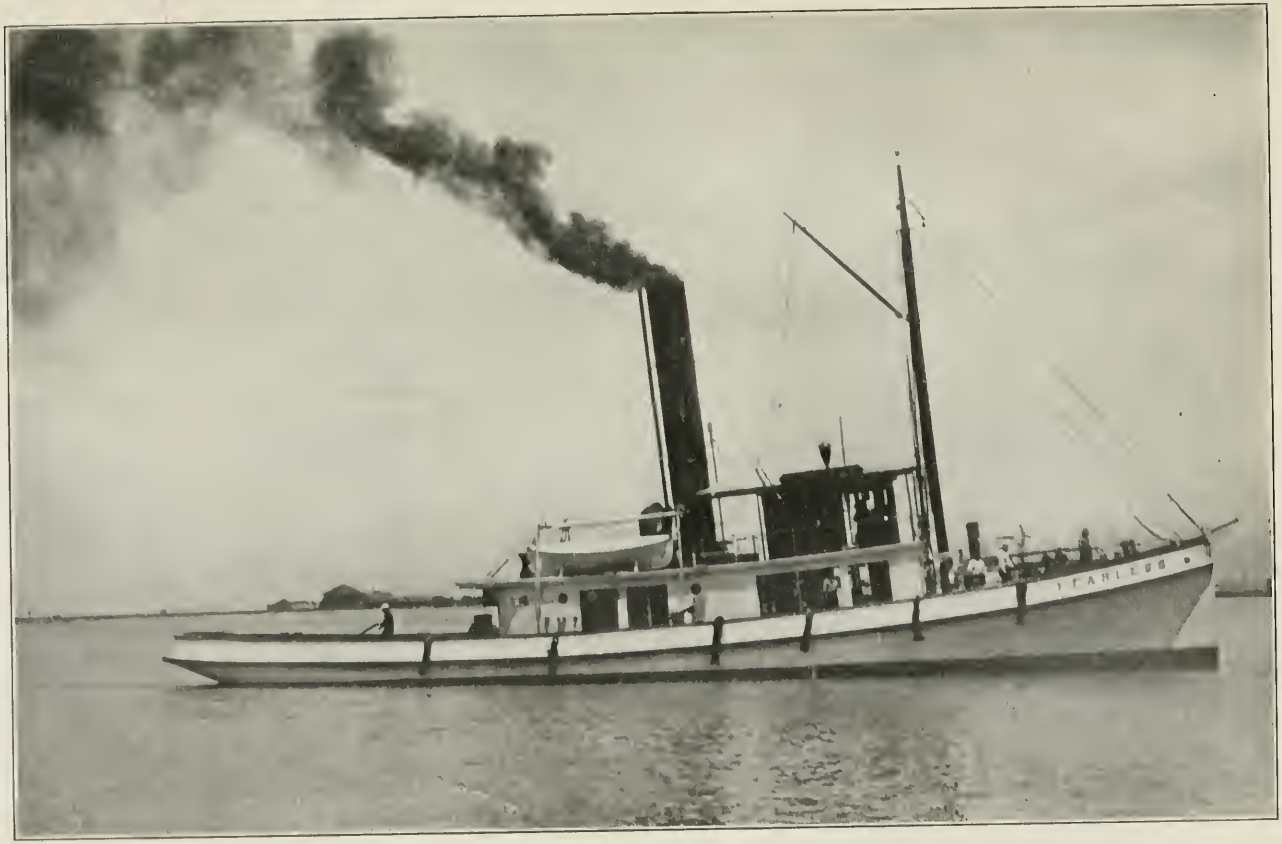


FIG. 2.—TYPE OF TUGBOAT USED AS BOARDING STEAMER.

FIG. 3.—A STEAM BOARDING LAUNCH, THE "OAHU," ATTACHED TO THE U. S. QUARANTINE STATION AT HONOLULU.

FIG. 4.—A BOARDING WHALEBOAT (HONOLULU QUARANTINE STATION).

for towing. Where large boarding steamers are required, vessels of the tugboat type may be especially constructed, or ordinary tugboats may be easily converted to fulfill the purpose.

Boarding steamers and launches.—For boarding in comparatively smooth water and where only short distances are to be traveled in reaching vessels waiting for quarantine inspection, small steam launches are commonly used and give universal satisfaction.

Vessels should be boarded promptly upon their arrival, within reasonable limitation. The approach of vessels is usually heralded through the courtesy of maritime marine exchanges or pilots, and the notice given is usually sufficient to enable the boarding steamer to reach the designated quarantine anchorage by the time the expected vessel arrives there. The boarding of vessels should not be attempted when the sea is rough enough to jeopardize the safety either of the boarding steamer or its personnel. The fact of the inability to board on account of the conditions above mentioned should be made known through the international signal code.

A boarding steamer should be kept in a state of perfect neatness, and manned by capable men under the proper discipline. The crew of the steamer should be required to wear the proper uniform and present in every way a businesslike appearance. When approaching a vessel the pilot must decide whether the big vessel is furnishing a proper lee, and also whether there are obstacles to a safe and sightly landing alongside. In the event conditions are not suitable, a quiet request for their adjustment should be made through the megaphone, the boarding vessel laying to in the meanwhile. A bungling or unseamanlike landing alongside of a vessel creates an unfavorable impression, to say the least, and is liable to cause a certain amount of confusion and excitement which is frequently ludicrous and which reflects discredit upon a function which should be deliberate from beginning to end.

Formality of boarding.—The traditional and customary hours for boarding vessels are between sunrise and sunset, and vessels arriving at quarantine during these hours should be boarded without delay. In cases of exigency and in order to give quick dispatch to the large ocean mail carriers it is good practice to board at night, provided an orderly muster is possible and ample artificial light available. The boarding officer, having arrived alongside the vessel, boards over the starboard side, provided the wind and sea permit. The starboard gangway, being by tradition the one used by officers, may usually be made safe if the pilot or commander of the vessel to be boarded swings his vessel so as to throw the starboard side to the leeward. It is always understood that all formality is to be disregarded in the event of rough weather or exigency. Upon arriving on board of sailing vessels and tramp steamers, it is well for the boarding officer to invite the presence

of the captain at once, but in the case of passenger steamers, the ship's surgeon and purser are the officials whose presence will prove of the greatest utility. The captains of large steamers usually leave all details to their heads of departments, and unless some important question arises it is well not to ask the captain to leave the bridge.

THE INSPECTION OF VESSELS.

The inspection of vessels is the most important part of quarantine work. Indeed, successful maritime quarantine depends almost entirely upon its proper performance. An inspection of a vessel includes the consideration of the sanitary history of all ports visited by the said vessel, the present health status or quarantine credit of these ports, the inspection of all persons on board, and the collecting of collateral evidence bearing upon the sanitary status of the vessel.

Upon reaching the vessel's deck it is well for the boarding officer to make a quick but general survey of the ship's personnel and passengers as they are grouped about. More than once have important disclosures been made to quarantine officers in answer to pointed questions, which an undue interest in the officer's arrival or an appearance of expectancy on the part of groups of passengers or crew had suggested. In any event during this quick survey it is well to ask a few general questions bearing upon the length of the voyage and the occurrence of incidents worthy of mention. It frequently happens that information of considerable importance may be accidentally imparted which would be suppressed on more formal inquiry.

The quarantine officer should keep himself posted concerning the sanitary history of all of the principal ports of the world, and should consider the bearing which the general sanitary history of a port may have upon the recent real or alleged health status thereof.

The recent sanitary status of a port is learned through the Public Health Reports published by the Public Health and Marine-Hospital Service, through the consular and other bills of health carried by the vessel, and from special information received either by wire or by letter from medical or consular officers at the ports previously visited by the vessel.

FIG. 5.—A MUSTER OF STEERAGE PASSENGERS. THE BOARDING LAUNCH STANDING BY READY FOR ORDERS.

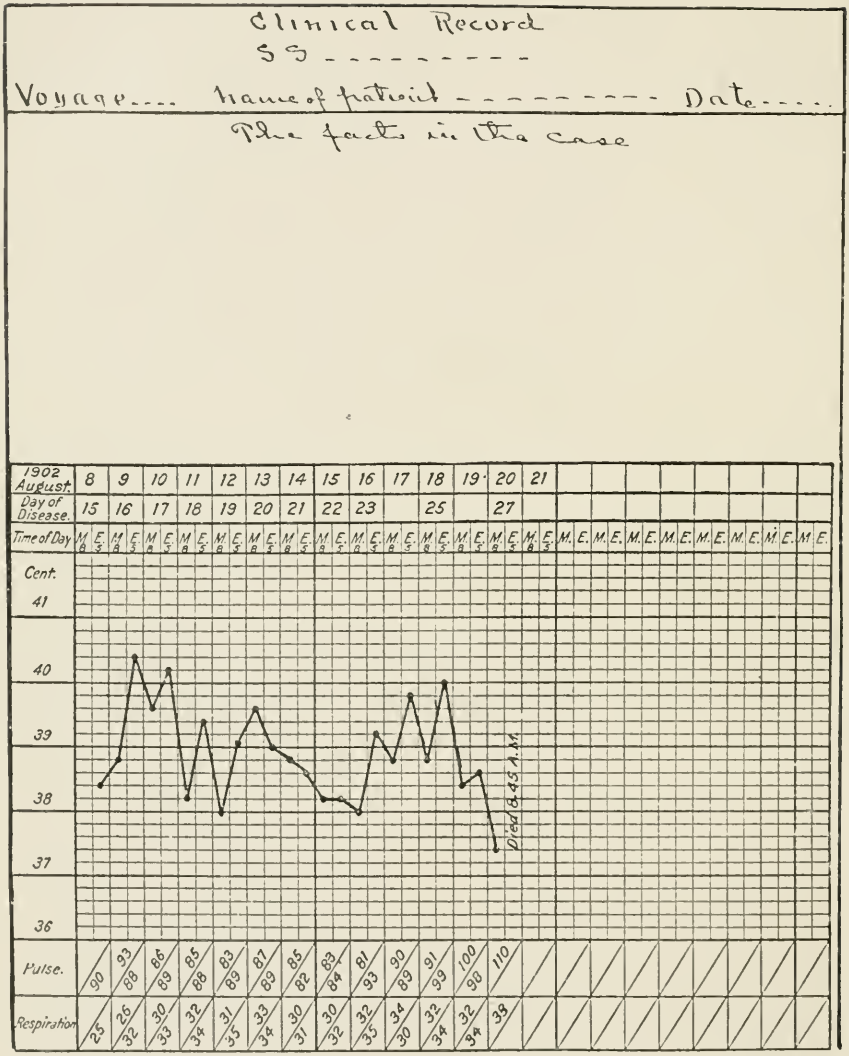


FIG. 6.—PROPOSED CLINICAL CHART FOR SHIP SURGEONS.

Sample improvised reference blank for recording the recent sanitary status of ports as obtained from bills of health.

ABSTRACT BILLS OF HEALTH.

S. S. "Hongkong Maru," arriving May 17, 1906.

Ports.	Two weeks ending—	Plague.		Cholera.		Smallpox.	
		Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
Shanghai	Apr. 22, 1906					7	3
Hongkong	Apr. 29, 1906	65	60			21	13
Amoy	Not visited						
Manila	do						
Nagasaki	May 2, 1906	Clean.					
Kobe	May 4, 1906	5	4				
Yokohama	May 8, 1906					2	0

From the bills of health a schedule of all persons on board should be quickly written out in the form of a memorandum.

Sample schedule for quarantine muster.

S. S. "Korea," arriving May 21, 1906.

Ports.	Embarked.				Disembarked.			
	First cabin.	Second cabin.	Steerage.	Crew.	First cabin.	Second cabin.	Steerage.	Crew.
Hongkong	77	0	62	279				
Shanghai	25	0	3	0	17	0	1	0
Nagasaki	5	0	2	0	14	0	3	0
Kobe	11	0	385	0	30	0	3	0
Yokohama	132	0	135	0	22	0	0	1
Total	250	0	587	279	83	0	7	1

The count of all persons on board when mustered should tally with the schedule.

The inspection of the vessel consists of an examination of all persons on board, and when necessary of the living apartments and hold of the ship.

The first step in the inspection of a vessel is an examination of all sick persons on board.

The clinical records, made out in the form prescribed, are carefully read. The patients are then examined, and the character of the surroundings and the element of isolation which they present are considered at the same time. After visiting the sick, the bodies of persons who have died at sea are viewed, and an autopsy performed if necessary. Next in order comes the general muster. It is needless to say that this must be entirely free from confusion. The purser is requested to assemble all first-cabin passengers in the dining saloon and have them take their places at the table. The roll is then called by the purser and each passenger rises in answer to name and passes

by the quarantine officer. The second-cabin passengers are inspected in a similar manner in their dining saloon. In mustering the steerage passengers, they should be further subdivided into nationalities.

These passengers are assembled on the spar deck aft. The method and extent of the examination of the steerage passengers varies with the disease or diseases existing at the vessel's port of departure or ports of call. Every inspection of groups of steerage passengers or crew includes a careful count of those present, and any discrepancy existing between the number found by the count and the number recorded in the memorandum for the ship's muster should be removed or satisfactorily explained. The face, forehead, and hands of everyone must be carefully examined. The deck force, firemen, and stewards are mustered separately on the spar deck forward and subjected to the same examination as that already described in the case of steerage passengers. The formal inspection of the vessel having been completed, the quarantine officer collects the collateral evidence as to the ship's sanitary status. The collateral evidence includes the general condition of the hull and the living quarters, the character and condition of the sanitary arrangements, and the condition of decks and holds as to general cleanliness. It also includes the question as to the probability of there being stegomyia mosquitoes on board, also the possible finding of dead rats during the voyage. The source of the water and vegetable supply and the kind of cargo carried are also considered in the light of collateral evidence. This concludes the ordinary port inspection.

THE JUDGMENT OF VESSELS.

The last step, the judgment of a vessel's sanitary status, is arrived at by weighing the findings of the inspection, that is, the conditions which were apparent at the time of the inspection, against the possibilities of concealed or latent infection.

Concealed or latent infection may apply either to the ship itself or to the personnel.

Concealed infection is usually concomitant with dishonest or ignorant captains or wily passengers and crew.

Latent infection is a condition dependent upon the character and condition of a vessel, her conduct while in an infected port, and the character of the quarantinable disease present in such port.

When a captain of a vessel compels men sick with quarantinable disease to stand in line to pass a quarantine muster, or makes a false certificate regarding the finding of dead rats on board during the voyage, he may be said to be concealing infection. On the other hand, when a passenger or member of the crew has had a very mild, modified, or attenuated attack of a quarantinable disease which has escaped all notice, the disease on the ship may be said to be latent.

The determination of concealed or latent infection in vessels is only possible after careful observation. Concealed or latent infection in vessels is the cause of most of the failures in maritime quarantine work, therefore it frequently happens that the quarantine officer is forced in the interest of public safety to impose the burden of proof as to the absence of latent or concealed infection upon the vessel.

The inspection of a vessel, as described above, only admits of the collection of some of the facts concerning the sanitary status of a vessel and its complement. In other words, only what is seen by the quarantine officer on the day and hour of the ship's arrival is known to him. That which may have happened on board during the voyage may be surmised or statements relative thereto may be accepted, but nevertheless nothing is supposed to be "known" for quarantine purposes except that which the quarantine officer sees either personally or through the agency of official certification which he is willing to accept.

The facts which may be gathered by the ordinary inspection comprise the information obtainable from the bills of health and the ship's papers, such as the sanitary history of the ports previously visited by the vessel, the existing sanitary status of the said ports, and the kind or kinds of quarantinable disease endemic therein. It is assumed of course that a vessel will always bring this information duly made out on the prescribed form and certified to by the United States consul or medical officer of the Public Health and Marine-Hospital Service, otherwise the act of 1893 will be violated and the vessel subjected to fine, and perhaps to detention in quarantine.

In addition to the facts enumerated above are those which the quarantine officer gathers through personal observation. These comprise the presence of quarantinable disease on board at the time of the inspection, the sanitary condition of the vessel, the type and nationality of the vessel, the various nationalities represented in the passenger lists, and the balance which an actual count of all persons on board makes with the number and classification recorded upon the consular or other bill of health. The apparent presence or absence of quarantinable disease is the most that can be determined by a single and perhaps cursory examination of a large number of passengers mustered especially for the occasion. Instances are rife where careful and conscientious quarantine officers have failed to detect cases of quarantinable disease in passengers who by means of careful planning were able to evade inspection. For example, a case of smallpox in the steerage of a vessel was successfully concealed for ten days from a ship's surgeon who was known to be very careful in his work. The case was discovered in hiding by one of three quarantine officers who searched the steerage of the vessel after

every one in sight had been sent to muster on the upper deck. It was found that the steerage passengers, upon learning that one of their number was suffering from smallpox, had concealed the man in order to escape the detention at quarantine which they knew would follow his detection. On another occasion a mess man suffering from bubonic plague was discovered during muster. The man had a temperature of 39.3° C., and a characteristic bubo, in the serum from which plague bacilli were shortly afterwards demonstrated. There is also a case on record of a sailor who while standing in the muster line waiting for inspection, turned aside and vomited black over the rail of the vessel. A cross-examination showed that he had been induced to leave his bunk only for the time being, the fact of his suffering from yellow fever being known at least to the captain of the vessel. These examples of "concealed infection" are cited to show that only the presence, not the absence, of quarantinable disease on board of a vessel can be determined as a fact when the evidence is based solely on the single inspection of a vessel made at the end of the voyage. In other words, the absence of quarantinable disease under these circumstances must always be classed as a supposition, not a fact.

The facts furnished by the type of vessel depend greatly upon the ease with which the hull itself may be inspected. In the modern ocean carrier more than ordinary attention is given to the condition of the hold, the keelsons, and the spaces under the dunnage planks. In such vessels inspections are not attended with great difficulty, as the passageways and holds are fairly well lighted. In the old type vessels, and especially in the case of tramp steamers, the condition of the hull can be determined, but only with more or less difficulty and personal discomfort to the quarantine officer. From the nationality of a vessel some idea of the degree of care necessary in determining the fact of cleanliness or uncleanliness may be had.

The nationalities represented by the passenger lists are elements which are accessory to facts. For example, Anglo-Saxon emigrants from the country districts are much more likely to be infected with quarantinable disease than those from the large cities, the reason for this being that vaccination is practiced more extensively in cities than in the country, and the city inhabitants of the emigrant class, having been exposed so constantly to all of the infectious and contagious diseases, possess an acquired immunity. Chinese coolies know by instinct when plague or the "black sickness" is among them. Their fear of the disease and their desertion of their sick when this disease is present may be taken into consideration as a fact against passengers of their nationality attempting to hide a case of plague occurring in their midst. On the other hand, the Chinese do not fear smallpox and they know nothing of yellow fever.

The Japanese, with their usual stoicism, disclose to the quarantine officer little or nothing where quarantinable disease is present among them. As a class they are well vaccinated and are clean of person. The Koreans are usually dirty of person, stupid as a class, and should be taken always as a risk.

The judgment of a vessel's status, if founded upon facts observed, must be determined solely in the premises outlined above. It happens, however, that other considerations force themselves upon the attention of the quarantine officer. These are conditions which the public at large imposes. The public cares not how many or how few facts the quarantine officer has at his disposal to guide him in his decision as to the sanitary status of a vessel. The quarantine officer is expected to render this decision immediately after his inspection of the vessel, and the said decision is expected to afford protection to the community and yet act as a sanitary sieve, not as a dam, to commerce. If the quarantine officer only had the facts above enumerated to consider, an opinion would always be prompt and, generally speaking, exact, but the probability of latent or concealed infection to which a large steamer, en route perhaps ten days from an infected port, is liable, renders a decision possible only after the consideration of the following conditions: First, the probable sanitary history of the voyage; second, the likelihood of latent infection; third, the personality of captain of the vessel; fourth, the likelihood of concealed infection; fifth, the attitude of the ship's surgeon; sixth, the kind of cargo carried.

The probable sanitary history of the voyage.—The probable sanitary history of the voyage involves the hazard of way-port traffic. For example, if 100 coolies of unknown origin board a vessel in Hongkong and leave her two days later at Shanghai, their presence on board may or may not have altered her sanitary status, but the number, nationality, and destination of the coolies, together with the general known sanitary condition of the port, would raise a question which might be used as collateral to facts. As a case in point, 70 Chinese sailors were once taken on board of a vessel at Hongkong, which vessel was destined to San Francisco via Shanghai, the Japanese ports, and Honolulu. At Nagasaki, five days later, the coolies were transferred to another vessel. Two days after their transfer one of the sailors died with bubonic plague. In the meanwhile the first steamer had sailed for Yokohama, and at the latter place the medical officer of the Public Health and Marine-Hospital Service learned of the incident and was able to report it to Honolulu. As no further case of disease had appeared on the passenger vessel the quarantine officer at Honolulu would have rated the probable sanitary history of the voyage as good, had he not received the information as stated above from the medical officer at Yokohama.

The likelihood of latent infection must be reckoned with, particularly in the case of such diseases as yellow fever or plague. Latent infection in the case of plague could be caused by an infected rat carrying infected fleas being introduced into a vessel with the freight. The following case illustrating latent infection occurred in a tramp steamer leaving Hongkong for San Diego via Honolulu. On the eighteenth day out of Hongkong, or three days before reaching Honolulu, a Chinese sailor died. He had been sick only two days prior to his death and throughout his illness lay in a stupor. It was thought that he was under the influence of opium, as he was greatly addicted to the use of the drug. Upon the arrival of the vessel at Honolulu the vessel was placed in quarantine on account of the sanitary history of the voyage. The captain denied ever having seen dead rats on board, and a daily examination of the crew showed them to be apparently in good health. The vessel, which carried freight for San Diego, Cal., could not be disinfected at Honolulu for the purpose of destroying rats and vermin, so she was allowed to sail for San Diego, after having been detained for eight days in quarantine at Honolulu, but all of the facts in the case were reported to the quarantine officer at San Diego and he was advised to disinfect the hold of the vessel upon her arrival there. On the fifth day out on the voyage to San Diego, thirteen days after her arrival at Honolulu and sixteen days after the death of the sailor, five deaths occurred, which even the captain upon his arrival at San Diego was convinced were from plague. The quarantine officer at San Diego noticed many dead rats in different parts of the vessel.

Latent infection with yellow fever could be caused by infected mosquitoes gaining an entrance into the hold of a vessel along with the freight or else by noninfected mosquitoes being present on the vessel and becoming first infected and afterwards infective from a mild or unrecognized case of yellow fever occurring on the voyage. Such infected mosquitoes might infect nonimmune stevedores at the port of arrival, or persons having residence contiguous to the shipping.

The personality of the captain of the vessel.—In the practice of quarantine, as in all phases of life, the personal equation must come in for consideration. The commander of a vessel is practically a king ruling over a floating world. People unconsciously look the second time at the "captain"—his ability, his knowledge, his courage, his probity are the qualities which they would know more about. In traveling on vessels passengers listen with attention to what the captain has to say, and soon opinions as to his general worth both as an officer and a man are formed. These opinions may be of small value from a technical point of view, but on the whole the composite opinion formed would describe the man with a fair degree of accuracy. While the world at large has admiration for the big-hearted, courage-

ous sailor, it only has respect in these progressive days for the sailor who adds to these desirable qualities those of education and breadth of mind. When fair-minded people hear the commander of a large ocean carrier speak in terms of denunciation of quarantine as an institution, an impression is certain to be formed that the said commander would through the fullness of his ignorance deny to his owners and his passengers and crew that sanitary protection which the whole medical world has pronounced necessary for the public good, and for which the whole people are annually contributing. That the quarantine officer should consider the master of the vessel as a factor in determining its status is but one of the signs of these progressive times. It is pertinent here to add that the time is coming, and quickly, too, when those commanders who lend the most aid to quarantine work and sanitary science will be the ones who will be placed on the largest vessels and on the most important runs, for the vessels offering the greatest safety to passengers and to communities will earn the greatest dividends for their owners.

The attitude of the ship's surgeon.—The attitude of the ship's surgeon is usually what the ship's owners make it. Some owners desire their surgeons to confine their attention solely to the treatment of the sick on board their vessels. Other owners instruct their surgeons to study the quarantine laws and apply them to the prevention of quarantinable diseases on board their vessels. All owners would have quarantine officers accept the statements and diagnoses of their surgeons, and all surgeons consider quarantine officers devoid of professional courtesy when they fail to accept such statements and diagnoses. The owners and the ship's surgeons are both wrong for the following reasons: First, the quarantine officer and not the ship's surgeon nor owner is the person directly responsible to the community for the sanitary condition of a vessel; second, the quarantine officer, on account of his experience with quarantinable diseases, is a far better judge than the ship's surgeon is likely to be of the many ways in which infection may manifest itself.

It is plain that the attitude of the ship's surgeon must be the one of witness. He must answer all of the quarantine officer's questions from the standpoint of a physician, but like a hospital interne he should not advance an opinion nor expect the quarantine officer to be influenced by it when advanced, for the reason above stated that it places the ship's surgeon in a partisan light. As a physician it is more proper and dignified for him to be neutral. But all ship's surgeons are not neutral; therefore the attitude of the ship's surgeon may be a factor to be reckoned with—the quarantine officer must judge of this.

The character of cargo carried.—A cargo is dangerous according to its general character. Coal, oil, ore, nitrates, and phosphates are

usually safe cargoes, while flour, cereals, grain, and foodstuffs are apt to harbor vermin, and are therefore open to question. General merchandise is dangerous, but principally because the spaces which usually intervene between the parcels may harbor vermin. A vessel may be found a safe risk in every other respect save in her cargo. A decision depending upon the status of the cargo is always a difficult one to make, as on the one hand the public health may suffer and on the other hand the vessel may be put to needless expense. After all, the quarantine officer must judge cargoes by the probability of their affording a habitat for intermediate hosts. For instance, coal and nitrate cargoes harbor very few if any rats. On the other hand, cargoes of foodstuffs, rice, flour, and the like are apt to harbor rats in large numbers. In deciding the status of a vessel the character of the cargo must be considered, and usually where the quarantine officer is not familiar with the conduct of the vessel at the loading port, the cargo must serve to discount the pratique rendered. For example, a large ocean carrier, having had a case of plague on board in the person of a Chinese fireman, which case was plainly chargeable to infection received on board ship, was detained for ten days in a foreign port and the usual disinfection performed in a manner which the medical officer of the Public Health and Marine-Hospital Service stationed in the said foreign port, certified as efficient save in one respect, and that was that not sufficient cargo had been removed to make it certain that many of the rats on board had been killed, and that all of those killed had been found. After the disinfection and detention, the vessel was given more cargo, but no mention was made as to whether the proper precautions were taken to prevent fresh ingress by rats. Upon arrival at the American port the pratique was modified to provide for a redisinfection of the vessel. After the disinfection by the "layer" method, which consists of disinfection after removing a layer of cargo 6 feet deep, the process being repeated until all of the cargo is out of the vessel, it was found that besides many rats which were mummified, there were many rats which had been only recently killed. Now, the question that at once arose was whether the rats newly killed came on board the ship with the new freight at the last port or whether they had lived through the first disinfection. It is reasonably certain that either explanation would have been sufficient so far as the elements of possibility and probability were concerned. The quarantine officer was suspicious of the vessel because her cargo was not a compact one, being composed of much bamboo ware, which is shipped lightly crated and in the hollow spaces of which rats can and do live.

A cargo of flour, rice, and sugar, if built up in a compact mass from the dunnage boards, does not furnish sacculated cavities or breathing spaces in which rats can live. It will be seen

FIG 7.—A MUSTER OF ORIENTAL PASSENGERS PRIOR TO THE DISINFECTION OF BAGGAGE.

from this brief synopsis of the many points to be considered in arriving at a conclusion as to the sanitary status of a vessel, that the home port inspection furnishes many more suppositions than facts. Therefore, the judgment of a vessel's status can only be obtained by a process of deduction, and the most successful quarantine officer is the one who forms the largest number of correct deductions.

The inspection and judgment of vessels in ballast.—The inspection of a vessel in ballast from suspected or infected ports should include a personal scrutiny of every accessible part of the hold. Vessels carry either water or hard ballast. Water ballast is carried in tanks arranged especially for the purpose. Water obtained from rivers or lakes where cholera, typhoid, or dysentery prevails is dangerous, while sea water may be considered safe. Hard ballast may consist of stone, sand, dirt from excavations, loam, and street sweepings. Unless ballast consists of hard rock or dry, clean sand, or sea water carried in ballast tanks, or otherwise unless it is certified to by an officer of the Public Health and Marine-Hospital Service as having been obtained in an uninfected locality, it should be discharged in deep water in the case of hard ballast, and pumped out into deep water in the case of water ballast.

An inspection of the hold will show whether the air streaks are sufficient, whether the bilges are in good condition, whether the spaces along the keelson and along the frames are free from rubbish or filth, whether the anchor chains have been washed free from mud, and whether the sanitary condition of the chain lockers is satisfactory. The general condition of the hold may be determined also by the sense of smell.

QUARANTINE TREATMENT.

In maritime quarantine work suspected or infected vessels, together with all persons and effects on board, are subject to what is known as quarantine treatment. Quarantine treatment comprises, first, the treatment of the sick; second, the management of persons occupying cabin quarters; third, the management of steerage passengers and crew; fourth, the treatment of baggage and personal effects; fifth, the treatment of the hull or vessel proper.

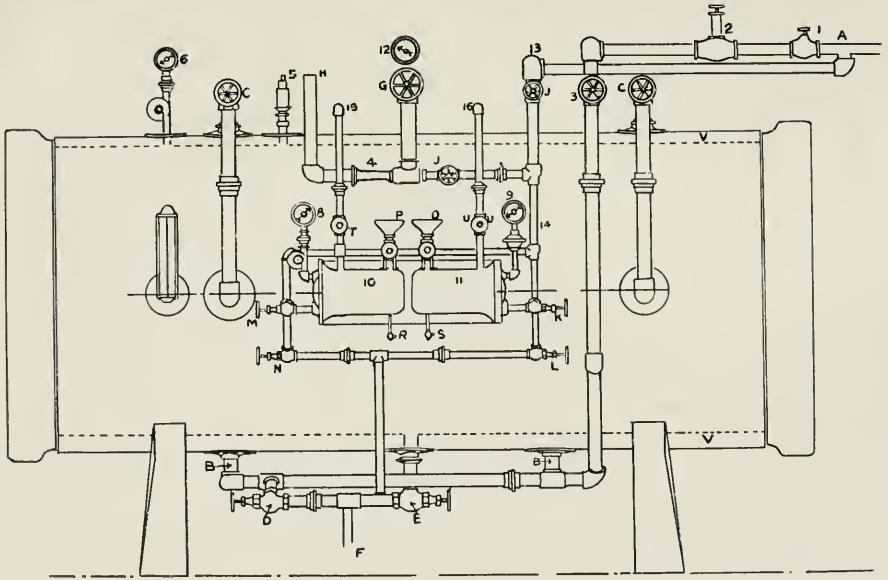
The treatment of the sick.—As soon as the vessel is brought alongside the quarantine station pier, the work of removing the sick is begun. The physical condition of one or all of those sick may not admit of such removal, and this point must be considered and decided by the medical officer. This applies to yellow fever during the second stage, or stage of remission, to cholera during the stage of collapse, and to smallpox during cold or inclement weather if the fever of eruption be present. A person suffering from a quarantinable disease, during the process of removal, should be carried in a stretcher,

the latter, together with the body and head of the patient, to be completely enshrouded by a clean sheet or binder of muslin. The sick, together with their effects are taken direct to the lazaretto without disinfection. The room occupied by the patient should be disinfected by means of sulphur in pots immediately after it is vacated.

The management of persons occupying cabin quarters.—In this class are included the first and second cabin passengers and those ship's officers who are accorded similar accommodations. These passengers are taken off in numbers corresponding to the capacity of the steam-disinfecting chambers. The ordinary 9-foot disinfecting chamber will handle on an average 12 cabin passengers an hour, therefore two of these chambers will disinfect the baggage of 24 cabin passengers an hour. The baggage from the staterooms, should it require disinfection, should be placed in gunny sacks and checks given for identification. The gunny sacks with their contained clothing are then placed in the steam chambers and disinfected. After the first cabin passengers are disposed of the second cabin passengers are treated in a similar manner. The cabin passengers are directed to their quarters on the station as soon as the disinfection is completed. The ship's dirty linen should be carefully gathered together and re oved for disinfection. As soon as the first and second cabin quarters are vacated, the disinfection of said quarters should be immediately begun. A small cooking pot containing the requisite amount of sulphur, the pot having been placed in a pan containing water, is set in each stateroom and fired and the door and window or port sealed up with mucilaged paper strips. The metal fixtures and gilt work in the staterooms should be greased with vaseline for protection against the action of the sulphur dioxid.

The management of steerage passengers and crew.—The steerage passengers are taken from the vessel as soon as the disinfection of the second cabin passengers is completed. Passengers of this class should be taken from the vessel in groups of 24, as the baggage of that number can be disinfected every half hour by two ordinary steam chambers 9 feet long. Should the capacity of the chambers be doubled, the number of passengers to be handled may be correspondingly increased. The baggage of the steerage passengers should be checked after it is properly arranged in the gunny sacks. While the steerage passengers are being removed their living quarters and the hatches leading to the holds should be prepared for disinfection by sulphur gas. The quarantine officer should obtain the assistance of the crew of the vessel in this important work.

Finally the personnel of the vessel is removed, the engineer's department first, then the steward's department, and finally the deck department. As each set of quarters is vacated and emptied, the sulphur pans are set and the compartments are rendered air-tight.



KINYOUN-FRANCIS DISINFECTING CHAMBER

1. Valve admits steam from boiler to reducing valve. 2. Reduces steam to pressure used in chamber. 3. Valve admits reduced steam to jacket at bottom 4. Vacuum apparatus 5. Safety valve 6. Steam pressure gage. 7. Thermometer. 8. Formaldehyd pressure gage. 9. Ammonia pressure gage 10. Copper formaldehyd retort. 11. Steel ammonia retort. 12. Vacuum gage. 13. High-pressure steam pipe to vacuum apparatus 14. Branch to formalin and ammonia retorts. 15. Copper pipe conducts formaldehyd gas to chamber. 16. Iron pipe conducts ammonia gas to chamber. A. Steam pipe from boiler B, B. Steam pipes to jacket. C, C. Valves admit steam from jacket to chamber. D. Drip valve from jacket E. Drip valve from chamber F. Outboard drip and circulation. G. Vacuum valve H. Exhaust pipe of vacuum apparatus. J. Valve admits high-pressure steam to vacuum apparatus. K. Valve admits high-pressure steam to ammonia coil. L. Drip from ammonia coil. M. Valve admits high-pressure steam to formaldehyd coil N. Drip from formaldehyd coil O. Filler for ammonia retort P. Filler for formaldehyd retort. R. Drain from formaldehyd retort. S. Drain from ammonia retort. T. Valve admits formaldehyd gas to chamber U. Valve admits ammonia gas to chamber V. The steam jacket.

FIG. 8.—DIAGRAM OF DISINFECTING CHAMBER (SIDE VIEW).

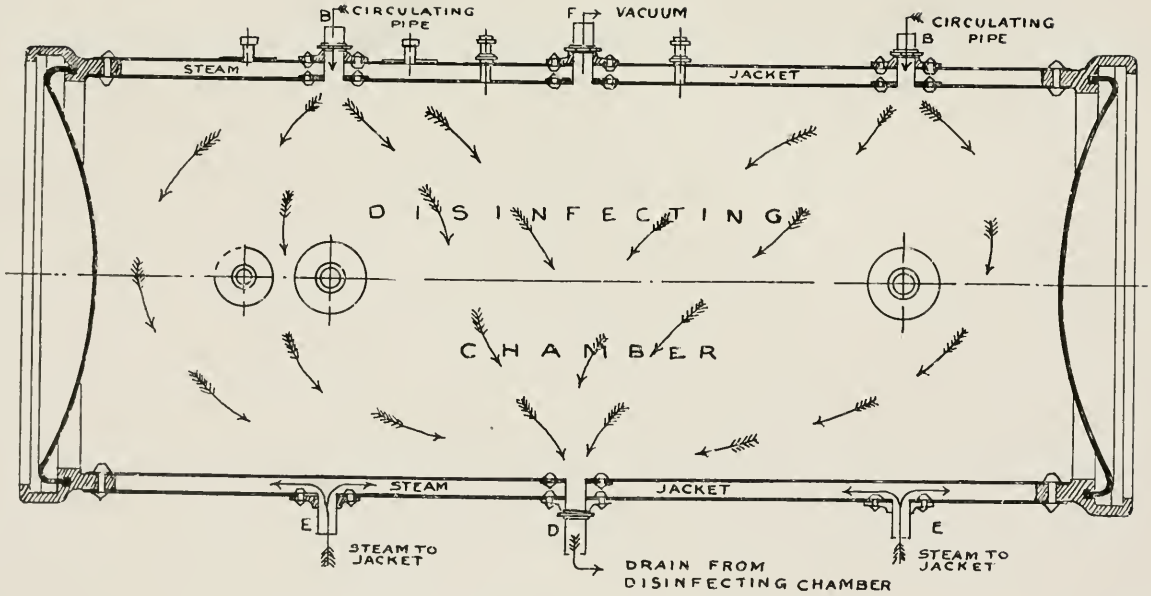


FIG. 9.—LONGITUDINAL SECTION THROUGH STEAM DISINFECTING CHAMBER.

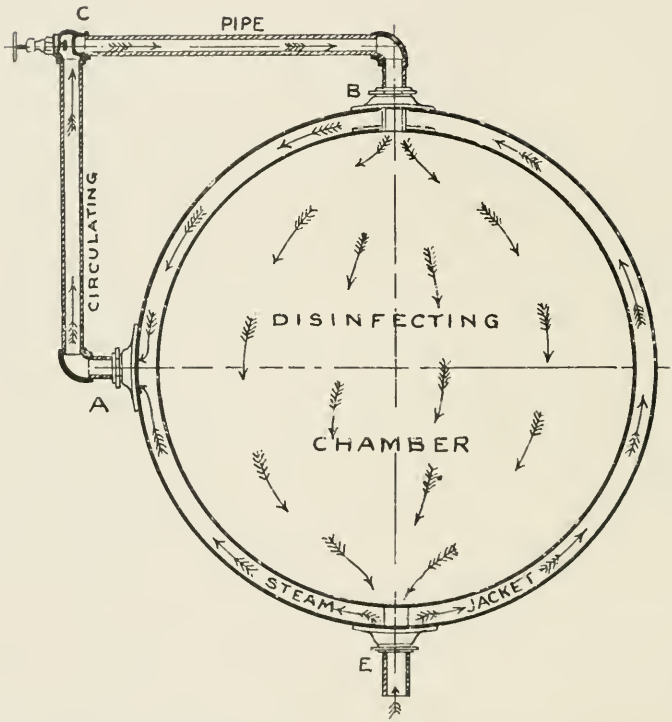


FIG 10.—CROSS-SECTION THROUGH STEAM DISINFECTING CHAMBER.

The crew are treated in a similar manner to the steerage passengers. As soon as the disinfection has been performed, both steerage passengers and crew are marched to the detention quarters at the quarantine station.

The treatment of baggage and personal effects.—Baggage and personal effects are disinfected by means of steam in steam chambers with or without formaldehyde.

The disinfection of fabrics, clothing and bedding in quarantine practice is usually accomplished by the use of either steam or formaldehyde in the Kinyoun-Francis steam chamber.

The Kinyoun-Francis steam chamber may be used with jetting steam or steam under pressure; with formaldehyde gas alone or in combination with dry heat; and also with a combination of these methods with or without a vacuum. The chamber is built of an inner and an outer shell. The steam jacket when heated prevents the condensation of steam in the disinfecting cylinder by heating the latter before the steam is turned in. This prevents the wetting of the clothes or other articles to be disinfected. In using the chamber with steam, either with or without pressure, the steam is kept continuously coursing through the jacket.

Loading the chambers.—The chambers must be loaded with care. The clothes should be hung up in the disinfecting cars and under no circumstances stuffed in. Clothes are usually loosely arranged in wire baskets or gunny sacks, which are then neatly arranged in the disinfecting car. The baskets or gunny sacks are numbered with metal checks with duplicates, the latter to be held by the owner of the baggage during the process of disinfection. All clothes should be protected from rust from the wire of the baskets and of the racks of the disinfecting cars by lining such wire surfaces with thin muslin. The thin burlap bag is also very useful in keeping the baggage of different persons separate and in affording it protection from the drip of condensed steam and from the rust from contact with wire or other metallic surfaces.

DIRECTIONS FOR OPERATING THE STEAM CHAMBERS.

(From the Annual Report U. S. P. H. and M. H. S., 1899.)

Steam disinfection.—(*a*) The chamber being cold, steam is admitted through the reducing valve 2 to the jacket *v*, care being taken to admit it very slowly at first to prevent sudden expansion and possible damage to chamber. Steam pressure must never exceed 10 pounds per square inch in either jacket or chamber.

(*b*) A proper temperature being obtained in the jacket (212° to 240° F.), the infected goods loaded in the car are pushed into the chamber, the doors are closed and made steam tight by means of the hand wheels.

(*c*) As soon as the temperature in the chamber is nearly as high as that in the jacket the exhauster is started and a vacuum of about 15 inches produced in the chamber, the exhauster being then shut off.

(*d*) By means of the circulating pipes A C B steam is very slowly admitted to the chamber from the jacket, the pressure in the chamber gradually raising to equal that in the jacket.

(*e*) The circulating pipe valves are now shut off and operations (*c*) and (*d*) repeated, after which the goods in the chamber are left exposed to steam at about 10 pounds pressure for a period ranging from fifteen to thirty minutes, depending on the character and compactness of goods being treated. The object of repeating operations (*c*) and (*d*) is to secure penetration and a high temperature (say, 230° F.) in the interstices of the exposed goods by means of the transmission of heat by the moisture from the steam and the removal of air by the exhauster.

(*f*) After the exposure the steam is shut off from the chamber and the vacuum again produced, all steam and moisture being carried off and the goods being thoroughly dried by heat from the jacket.

(*g*) Air is then admitted by opening the exhauster discharge valve, the doors are opened, and the car and goods removed. No articles such as leather or books, which may be injured by steam heat, are exposed to this process.

Operation of formaldehyde disinfection.—In the retort marked "Formalin" is poured the desired quantity of the formalin mixture which is usually prepared under the following formula: 1,000 parts (by volume) of formaldehyde (H.CHO) 40 per cent strength; 200 parts (by volume) of calcium chloride ($CaCl_2$); 400 parts (by volume) of water (H_2O).

The calcium chloride is dissolved in the water and filtered, after which the formaldehyde is added. This mixture is poured into the retort and all valves closed. To generate the gas the valve to the steam coil is opened and the heat will cause rapid vaporization. The pressure on the retort, as shown by the gauge, should never be allowed to exceed 40 pounds. When this pressure is nearly reached, the apparatus is ready for use.

The steam chamber being filled with goods to be treated with formaldehyde, and operations (*a*), (*b*), and (*c*), (as for steam) having been performed, the valve in the pipe connecting the formaldehyde retort to the chamber is opened very slightly (to avoid lifting the liquid in the retort by the vacuum in the chamber) and the gas is allowed to pass into the chamber until the pressure in the retort drops to nearly zero. The remaining liquid in the retort is again heated by the steam coil and, as before, when the pressure is nearly 40 pounds the gas is admitted to the chamber. It is usually necessary to heat the retort two or three times before the chamber is entirely filled with the gas.

The amount of formalin required can be computed by consideration of the volume of the chamber. One liter (61.0271 cubic inches) of formalin will evolve about 1,450 liters of the gas. The volume of one chamber is 435,951 cubic inches and that of the retort 1,526.64 cubic inches, the ratio being such that if the retort is one-fifth filled with formalin originally it will entirely fill the chamber with the gas, provided all the formalin is vaporized.

In case the goods being treated are such as would be damaged by a dry heat of more than 100 degrees (as leather goods), operations (*a*), (*b*), and (*c*) are so modified as to keep the temperature as desired; that is, only enough steam is admitted to the jacket to slightly warm it.

After the goods are exposed for the proper time to the formaldehyde gas (the time varying from ten to twenty minutes, according to the nature and density of goods being treated), the retort valve is shut off and operation (*f*) proceeded with.

Then ammonia gas from the ammonia retort is admitted to the chamber to neutralize the irrigating effects of the formaldehyde gas. Only a small quantity at low pressure is required. The method of operating the ammonia retort is exactly the same as that for the formalin retort, excepting that commercial aqua ammonia

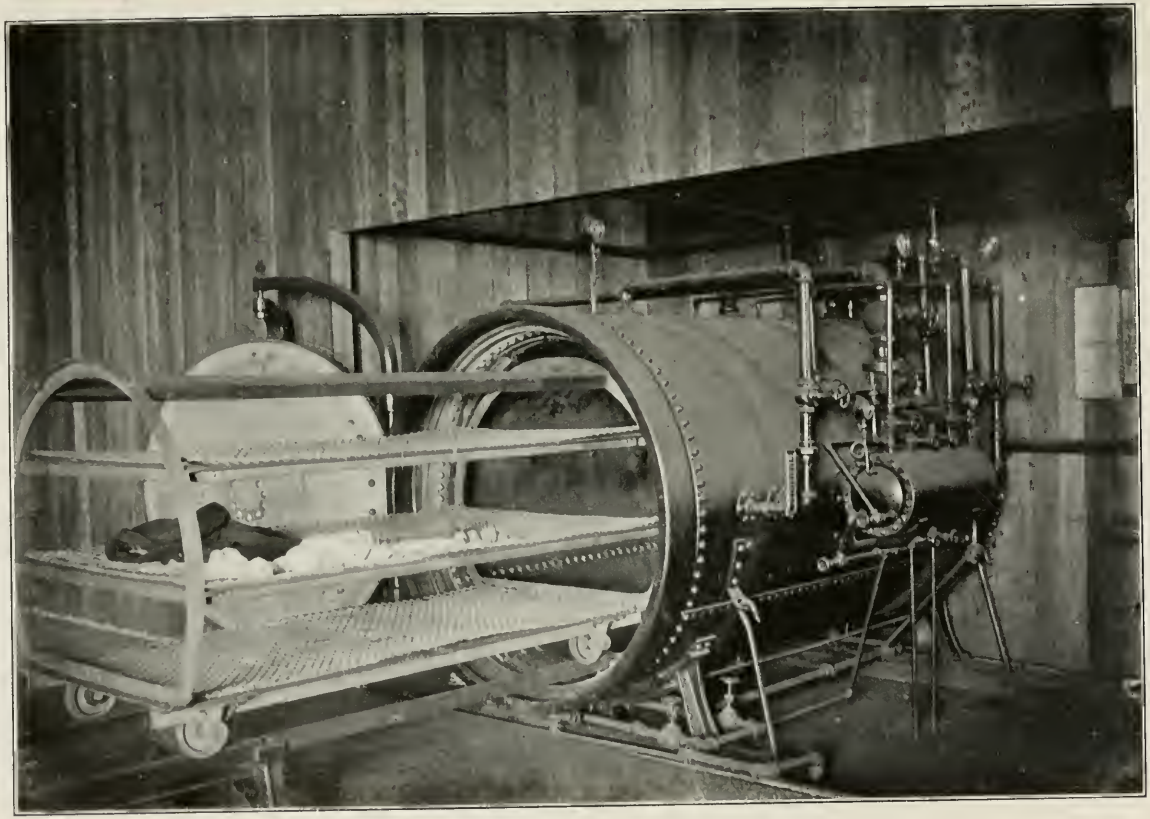


FIG. 11.—A STEAM CHAMBER PROPERLY INSTALLED ("INFECTED" END).

is used. After exposure to this gas for about three minutes, operation (*f*) is repeated, and then operation (*g*) is proceeded with.

The disinfection of the hull or vessel proper.—The disinfection of a vessel requires on the part of the disinfector some familiarity with the general arrangement of the interior of vessels and a certain amount of ingenuity. A vessel is seldom so badly infected as to require disinfection throughout. The hazard of an infected vessel varies according to the nature of the disease with which it is actually or presumably infected. Therefore it is frequently very difficult to decide just what parts of a vessel and just what personal effects should be disinfected. There is no reason why the staterooms of the first-cabin passengers should be disinfected because there is a case of smallpox in the steerage or in the quarters of the crew. Likewise there is no reason to disinfect the hold of a vessel and break the cargo in bulk because of a case of smallpox, cholera, or typhus fever in the cabin or steerage. Therefore an infected vessel requires definite and especial quarantine treatment according to the nature of the disease with which it is infected. For example, in vessels infected or suspected of infection with cholera, especial attention must be paid to the drinking water on board, and the vegetables and fruits as well. In the case of plague the destruction of rats and other vermin is of first importance. For yellow fever, measures must be taken against the presence of stegomyia mosquitoes, and for smallpox and the eruptive fevers the usual disinfection of living apartments, clothing, bedding, and the personal effects of those exposed to infection is required. After the quarantine officer has made a thorough inspection of the vessel he can determine the exact extent to which he will carry the process of disinfection. Such rooms as the carpenter shop, chain lockers, rope and sail lockers, lamp lockers, paint rooms, chart room, pilot house, engine and boiler rooms, machine shop, shaft alleys, and turtlebacks are usually not infected, and therefore require no disinfection. It may be necessary, however, to fumigate these places for the destruction of rats and mosquitoes. The dining saloons, social halls, and smoking rooms usually contain a great deal of metal and gilt decorations, which are ruined by sulphur; therefore, the metal and gilt work in such compartments, when fumigation is required, should be protected by a coating of vaseline. Any portion of a vessel which is dirty and which requires mechanical cleaning should be ordered cleaned at once before the regular work of disinfection is begun. The principal agents used in the disinfection of the vessel proper are sulphur dioxide, formaldehyde gas, and bichloride of mercury.

SULPHUR DIOXIDE.

Sulphur dioxide is the most efficient of all of the disinfectants so far as the holds of a vessel or compartments are concerned. It is equally destructive to animal and vegetable life, and is therefore invaluable in quarantine practice in destroying contagion that is transmitted through the agency of mosquitoes, fleas, bed bugs, rats, and mice. Its action requires the presence of moisture in some form. The gas diffuses slowly and has very little penetrating power. Therefore the use of sulphur gas should be limited to the disinfection of surfaces, it being unsuitable for the disinfection of bedding, mattresses, and fabrics. It does not kill spores, and is therefore inapplicable to diseases caused by spore-forming organisms. It should be borne in mind that sulphur gas bleaches all fabrics colored with vegetable dyes, and has a disintegrating action upon cotton and jute fabrics, such as sugar and fertilizer bags.

METHOD OF COMPUTING THE AMOUNT OF SULPHUR REQUIRED FOR THE DISINFECTION OF HOLDS AND COMPARTMENTS OF VESSELS.

One pound of sulphur burned in a space containing 1,000 cubic feet will produce 1 per cent of the gas. Five pounds of sulphur burned in a space containing 1,000 cubic feet will produce 5 per cent of the gas. This latter volume strength of gas is sufficient to kill all nonspore-bearing organisms after sixteen hours' exposure. With 2 pounds of sulphur for every 1,000 cubic feet, two hours' exposure is sufficient to kill mosquitoes and vermin.

In computing the capacity of the hold of a vessel for the purpose of determining the number of thousand cubic feet of space therein, and therefore the number of pounds of sulphur which will be required to produce a 5 per cent volume of the gas, the net tonnage of the vessel indicates in a general way the cubic capacity of her cargo-carrying space. Ten net tons will represent 1,000 cubic feet of space; therefore, for every 10 net tons 5 pounds of sulphur must be used to get the approximate 5 per cent volume strength. The capacity of the living apartments, storerooms, and the like had best be computed separately.

THE SEALING OF HOLDS AND COMPARTMENTS.

In disinfecting with sulphur gas all spaces must be rendered airtight. In disinfecting the holds of vessels the hatches should be covered over with their regular waterproof tarpaulins and tightly battened down, leaving a vent for the escape of the sulphur. All air streakes, scuttles, and chain ports should be closed. The doors should be sealed by means of strips of paper pasted over the intervals left between the frame and the door.

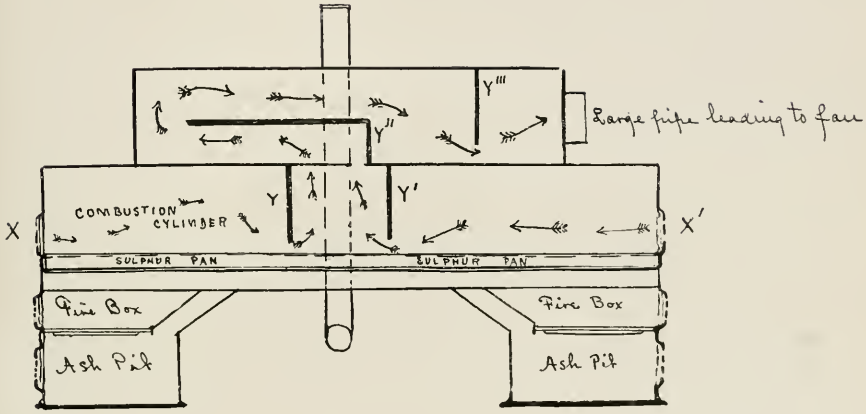


Diagram of sulphur furnace used by the U.S. Public Health & Marine Hospital Service.

FIG. 12.

FIG 13.—SHOWING SULPHUR PAN IN POSITION, ALSO AUTOCLAVES AND HAND BICHLORIDE PUMP.

SULPHUR FUMIGATION.

In quarantine practice sulphur fumigation is usually effected by the combustion of sulphur either in furnaces especially constructed or designed for the purpose or in ordinary iron pots. Sulphur either in the form of flowers of sulphur or roll sulphur is suitable for the purpose.

THE SULPHUR FURNACE.

The sulphur furnace adopted by the Public Health and Marine-Hospital Service is shown in Fig. 12. A thin layer of sulphur is spread upon the sulphur pan, the sulphur being introduced through the doors X and X′ at both ends of the combustion cylinder of the furnace. These doors are provided with openings or dampers through which the air passes over the burning sulphur, and by which the amount of air entering the combustion cylinder is regulated. Only enough air should be admitted to keep the sulphur burning with a low blue flame, as a draft will only carry over molten sulphur which will sublime on cooling and clog up the pipes. The sulphur fumes pass around the break plates Y, Y′, Y″, and Y‴, as shown by the arrows in the drawing, in order to make the combustion of the sulphur complete, or in other words, to complete the combustion of the oxygen in the air, forming SO_2, or sulphur dioxide or sulphur gas. After passing the last break plate Y‴ the fumes enter the large pipe leading to the fan, the latter serving to aspirate the fumes from the combustion cylinder to the hold of the ship or other place to be fumigated. The fan, which is usually placed close to the sulphur furnace, is run by an engine, the governor of which should be set to allow not more than 350 revolutions of the fan to the minute, otherwise the oxygen of the air will not all be combined, with the sulphur, into sulphur dioxide. Running the fan at a speed higher than that mentioned above will also cause overheating of the sulphur pipes, and perhaps by the carrying over of sparks cause a fire to break out in the hold of the vessel. This rule should be strictly observed by medical officers. After counting the revolutions of the fan by means of a speed indicator, one learns to tell at a glance whether or not the fan revolutions are in excess of 350 to the minute. After the sulphur gas passes through the fan it is conveyed into the hold of the vessel through galvanized iron or composition rubber pipes made for the purpose. The pipe is carried through a small hole especially made in the hatch covering by means of a small saw, and then let down into the hold of the vessel until it is near the bilge. Sulphur gas, being heavier than air, collects at the bottom and gradually ascends, so that it is important to leave an opening in the hatch covering for the exit of the air near the top. This opening should not be closed until sulphur gas begins to escape freely. During the

disinfection of a hold of a vessel or compartment vapor should be supplied by a steam jet run through flexible steam hose from the boiler, or else a few buckets of water should be placed in the ship's hold.

SULPHUR DISINFECTION BY THE USE OF POTS.

Almost any kind or size of iron pot will answer the purpose. The ordinary sugar pan 2½ feet in diameter is useful in disinfecting the hold of a vessel or a large compartment, the number of pans to be determined by the number of thousand cubic feet of area to be disinfected. Not more than 30 pounds of sulphur should be placed in each pot. For the disinfection of staterooms and the like small iron cooking vessels are suitable. Each pot should always be placed in a tub of water, as shown in the illustration. The tubs should be made of wood or compressed paper, as tubs made of galvanized iron or composition metal deteriorate rapidly through rust or breaks in the seams. The pots should never be placed on the floor of a compartment or bottom of the hold of a vessel. In compartments or rooms they should be placed upon tables or chairs, and in the holds of vessels either on the "tween" decks, upon piles of ballast, or upon improvised stands. The sulphur should always be ground or mashed into a powder before being placed either in the pots or in the sulphur furnace. In using the sulphur in the furnace the former may be spread out evenly or flat upon the sulphur pan, but in pots the sulphur should be piled around the sides with a central depression or crater. Alcohol should always be used for lighting sulphur, although a hot coal will answer the purpose.

FORMALDEHYDE GAS.

In quarantine practice this gas is most conveniently and efficiently used by means of the autoclave. By the use of the autoclave the gas is produced from its solution under pressure, and not only is the gas evolved in a very short time, but good penetration and diffusion is obtained. The autoclave consists of a copper retort constructed to withstand the required pressure. The retort is provided with a filling funnel, a water gauge, a pressure gauge, and a small outlet pipe, to which a long copper tube may be screwed, said long tube being small enough to be introduced through the keyhole of a door. The retort is also provided with a safety valve to prevent accidents. The heat is supplied by means of the ordinary Primus lamp. The solution used consists of formalin, 40 per cent, with 20 per cent of calcium chlorid, or some other neutral salt such as common table salt. Ten ounces of the solution should be used for each 1,000 cubic feet of space to be disinfected. The retort usually holds 1 liter of the solution, enough for the disinfection of 3,000 cubic feet of air space. In using the autoclave fill the retort, close all valves, light the lamp,

and bring up the pressure by degrees. Open the outlet frequently as the pressure rises in order to drive out the heated air. When the pressure reaches 45 pounds, open the outlet valve and permit the gas to enter the compartment to be disinfected. With the pressure maintained at 45 pounds, it will require about twenty minutes to evolve the gas from the liter of the solution. After the formaldehyde gas has escaped within the compartment the steam from the retort should be allowed to enter the compartment in order to furnish the moisture necessary for the maximum disinfecting power of the gas. The retort should be charged separately for each compartment to be disinfected. A compartment disinfected in this manner should be left sealed and exposed from three to twelve hours. Fabrics and clothes hung up loosely in a compartment may be disinfected at the same time, but the exposure should last for twelve hours.

BICHLORIDE OF MERCURY SOLUTION.

A large quantity, at least 2,000 gallons, of a solution of bichloride of mercury, of the strength of 1 to 1,000, should be kept on hand at every quarantine station ready for immediate use. Bichloride of mercury dissolves in 16 parts of cold water and 3 parts of boiling water.

The solubility of the bichloride will be increased by either using sea water or adding sodium chloride to the fresh water in the proportion of 2 parts to 1,000. In making the solution a gallon of water may be made to approximately represent 4 liters, so that for every gallon of sea water 4 grams of bichloride should be added; therefore 50 gallons of solution would require 200 grams, or about 7 ounces, of bichloride; 1,000 gallons of solution, 4,000 grams, 4 kilograms, or 8.8 pounds, of bichloride; and, finally, 5,000 gallons of solution, the amount which should be constantly on hand at a quarantine station, would require 44 pounds of bichloride of mercury. This solution should be stored in 2,000-gallon wooden tanks placed at a high elevation in order to obtain pressure. It is better, however, that a steam pump be provided for the purpose of giving the solution the proper force when used in the holds of vessels, particularly those of wooden vessels in which there are many cracks and crevices which should be thoroughly treated with the solution. The steam pump should have a 2-inch suction pipe with a 1½-inch discharge. The water end should be made of iron and the nozzles and spray ends of hard rubber. After using the pump it should be washed out by means of a standpipe running for this purpose into the separator. The hose used should be 1½ inches in diameter, and should be provided with a combination straight and rose-jet nozzle. The straight nozzle is intended for use in spraying cracks, crevices, and irregular surfaces. For mixing the solution it is convenient to have on hand several packages of

finely powdered bichloride of mercury weighed out in the amount, or in the multiples thereof, necessary for the solution required, as judged by the capacity of the tank.

The solution may be mixed in concentrated form, using sea water for the purpose, and then added to the big tank, or else mixed in the latter by placing the bichloride in a box perforated by fine holes, the said box, into which the feed pipe is carried, being suspended over the tank. In other words, the sea water is made to percolate through the bichloride in the perforated box.

The disposition of a vessel after disinfection.—The disposition of a vessel after the complete disinfection of her hull depends upon whether it is desired to detain the personnel on board or at the quarantine station. After the hull of a vessel has been disinfected there is no reason why the vessel itself should not be allowed to proceed to port in charge of a clean crew, the personnel remaining at the quarantine station during the detention period required. Should it be necessary to detain any or all of the personnel or passengers of the vessel on board, the vessel is ordered to a specified anchorage. During the period of detention all hands on board should be inspected morning and afternoon. If the period of detention passes without the further appearance of quarantinable disease, the vessel is given pratique. In the event of the reappearance of disease, the whole process of disinfection and detention must be gone through again, the detention dating from the completion of the last disinfection.

THE HOUSING AND SUBSISTING OF PASSENGERS AND CREW.

The passengers and crew are assigned to quarters in groups or detachments immediately upon the completion of the disinfection of baggage, if the latter process be required. The quarantine officer is then expected to provide for, satisfy, and control several large, and from a social standpoint, widely separated groups of people. In other words, he must conduct a small first-class hotel, a second-class hotel, a third-class hotel, and if there are Orientals to be detained, a large oriental camp. Each group of persons must be fed and served in a degree at least comparable with what they have recently become accustomed to on board the vessel. The cabin passengers must be induced to limit as much as possible the amount of baggage to be taken to the quarters. They must be assigned to rooms as far as possible with reference to their preferences regarding their shipmates. It is needless to say that the cleanly and orderly condition of the floors, windows, china ware, beds, and linen in the rooms must be such as to at least silence criticism if not to evoke some measure of praise. This same state of affairs should also prevail in the dining room and kitchen.

In providing for the subsistence of first-cabin passengers, the following meal schedule and the daily subsistence requisitions covering it are given as an aid in making quick provision for passengers of the cabin class. The daily subsistence requisitions provide for 20 cabin passengers.

Bill of fare, quarantine station.

SUNDAY.

Breakfast.	Dinner.	Supper.
Mush and milk.	Cream and celery soup.	Cold meats.
Ham and eggs (2).	Chicken fricassee.	Potato salad.
Baked potatoes.	Mashed potatoes.	Boiled potatoes.
Rice.	Roast sweet potatoes.	Rice.
Buckwheat cakes.	Corn.	Canned fruit.
Maple sirup.	Tomato salad.	Cake.
Orange.	Sweet pudding, with lemon sauce.	Tea.
Coffee.	Coffee.	

MONDAY.

Mush and milk.	Soup.	Cold meats.
Mutton chops.	Pot roast.	Fried salmon.
Fried potatoes.	Brown potatoes.	Fried potatoes.
Rice.	Creamed cabbage.	Rice.
Yeast biscuits.	Beet salad.	Vermicelli and cheese.
Honey.	Apple dumplings.	Prunes.
Coffee.	Sirup.	Tea.
	Tea.	

TUESDAY.

Mush and milk.	Mutton-broth soup.	Round steak.
Sausage.	Leg mutton, stewed.	Boiled potatoes.
Fried potatoes.	Peas.	Fried onions.
Rice.	Boiled potatoes.	Apple fritters.
Corn cake.	Horseradish.	Rice.
Sirup.	Cold slaw.	Sirup.
Bananas.	Tapioca pudding, lemon sauce.	Tea.
Coffee.	Cold meats.	

WEDNESDAY.

Mush and milk.	Tomato soup.	Cold meats.
Papaya.	Rib roast.	Baked beans.
Boiled eggs (2).	Dressing.	Boiled potatoes.
Fried potatoes.	Boiled potatoes.	Rice.
Rice.	Creamed onions.	Gingerbread.
Corn bread.	Boiled sweet potatoes.	Tea.
Coffee.	Celery salad.	
Sirup.	Pie, fruit.	
	Tea.	

THURSDAY.

Mush and milk.	Vegetable soup.	Cold meats.
Pork chops.	Roast veal, dressing.	Potato cakes.
Fried potatoes.	Mashed potatoes.	Rice.
Rice.	Lima beans.	Stewed apples.
Soda biscuits.	Cheese salad.	Cake.
Honey.	Peach cobbler, with milk and sugar.	Tea.
Coffee.	Codfish hash.	

Bill of fare, quarantine station—Continued.

FRIDAY.

Breakfast.	Dinner.	Supper.
Mush and milk. Salt mackerel. Round steak. Boiled potatoes. Rice. Muffins. Papaya. Coffee.	Soup. Fried mullet. Corned beef. Boiled potatoes. Cabbage. Roast sweet potatoes. Cornstarch pudding, vanila sauce. Veal salad. Tea.	Hamburg steak. Tomato, Spanish sauce. Cold corned beef. Boiled potatoes. Rice. Prunes. Tea.

SATURDAY.

Mush and milk. Corned-beef hash. Fried potatoes. Rice. Corn cake and sirup. Bananas. Coffee.	Soup. Roast pork, apple sauce. Brown potatoes. Baked sweet potatoes. Turnips. Fish salad. Pumpkin pie. Cheese. Tea.	Sirloin steak. Baked potatoes. Macaroni and cheese. Rice. Doughnuts. Tea.

Requisitions.

SUNDAY, AUGUST 5, 1906.

Chicken	pounds	16
Rump roast	do	4
Mutton chops	do	8
Tomatoes	do	5
Green corn	do	3
Celery	do	1
Milk	quarts	7
Ice	pounds	50
Bread	do	12
Potatoes	do	20

Miscellaneous groceries, etc.: Ham, eggs, coffee, sugar, butter, fruit, poi, etc.

MONDAY, AUGUST 6, 1906.

Rump roast	pounds	8
Sirloin steak	do	8
Sweet potatoes	do	25
Cabbage	do	8
Beets	do	6
Fruit	do	9
Onions	do	8
Milk	quarts	7
Ice	pounds	50
Bread	do	12
Potatoes	do	20

Miscellaneous groceries, etc.: Flour, rice, coffee, sugar, fruit, honey, cheese, etc.

TUESDAY, AUGUST 7, 1906.

Rib roast	pounds	8
Rump roast	do	7
Loin pork	do	10
Fruit	do	15
Lettuce	do	3
Tomatoes	do	2

TUESDAY, AUGUST 7, 1906—Continued.

Lemons	dozen	1
Milk	quarts	7
Ice	pounds	50
Bread	do	12
Potatoes	do	20

Miscellaneous groceries, etc.: Flour, rice, corn meal, sirup, fruit, coffee, tapioca, etc.

WEDNESDAY, AUGUST 8, 1906.

Leg mutton	pounds	10
Rump roast	do	6
Bacon	do	3
Milk	quarts	7
Ice	pounds	50
Bread	do	12
Potatoes	do	20

Miscellaneous groceries, etc.: Flour, oatmeal, fruit, coffee, sirup, rice, sugar, etc.

THURSDAY, AUGUST 9, 1906.

Leg veal	pounds	8
Rump roast	do	5
Codfish, boneless	do	4
Salt pork	do	5
Salt mackerel	do	2
Fruit	do	15
Onions	do	8
String beans	do	2
Milk	quarts	7
Ice	pounds	50
Bread	do	12
Potatoes	do	20

Miscellaneous groceries, etc.: Honey, sugar, coffee, flour, rice, fruit, etc.

Requisitions—Continued.

FRIDAY, AUGUST 10, 1906.

Corned beef	pounds..	8
Mullet	do....	8
Rump roast	do....	7
Sirloin steak	do....	4
Lettuce	do....	3
Sweet potatoes	do....	25
Cabbage	do....	8
Milk	quarts..	7
Ice	pounds..	50
Bread	do....	12
Potatoes	do....	20

Miscellaneous groceries, etc.: Sugar, fruit, coffee, rice, butter, oatmeal, etc.

SATURDAY, AUGUST 11, 1906.

Loin pork	pounds..	6
Sirloin steak	do....	6
Round steak	do....	4
Rump roast	do....	6
Halibut	do....	3
Lettuce	do....	3
Fruit	pounds..	10
Pumpkin	do....	6
Milk	quarts..	7
Ice	pounds..	50
Bread	do....	12
Potatoes	do....	20

Miscellaneous groceries, etc.: Oatmeal, sirup, rice, cheese, sugar, coffee, fruit, etc.

SUNDAY, AUGUST 12, 1906.

Turkey	pounds..	16½
Rump roast	do....	4
Corn	do....	12
Lettuce	do....	3
Loin pork	do....	8
Milk	quarts..	7
Ice	pounds..	50
Bread	do....	12
Potatoes	do....	20

Miscellaneous groceries, etc.: Eggs, ham, fruit, butter, flour, sugar, sirup, etc.

It is almost impossible to really please a lot of first-cabin passengers, for whom a quarantine station and its associations hold nothing but horror and with whom time necessarily drags, but if there is one expedient to which the quarantine officer can resort which tends to quiet discontent more than any other it is the universal serving of hot bouillon and biscuit at 10.30 a. m. and tea and toast at 4.30 p. m. in addition to the regular meals. Such seemingly absurd expedients are mentioned that they may be considered as advice and their value and importance verified by actual trial.

Passengers of the second class and steerage, members of the crew, and United States sailors and soldiers are subsisted by the regular diet schedule of the Public Health and Marine-Hospital Service.

DIET TABLES.

Ordinary Diet.

BREAKFAST.

Monday.

Coffee	pint..	1
Bread	ounces..	6
Butter	ounce..	½
Meat hash, with vegetables	ounces..	6
Stewed fruit[a]	do....	3

Tuesday.

Coffee	pint..	1
Bread	ounces..	6
Butter	ounce..	½
Corned-beef hash, with potatoes	ounces..	6

Wednesday.

Coffee	pint..	1
Bread	ounces..	4
Butter	ounce..	½
Fish hash, with vegetables	ounces..	6

BREAKFAST—Continued.

Thursday.

Coffee	pint..	1
Bread	ounces..	6
Butter	ounce..	¾
Meat stew	ounces..	6

Friday.

Coffee	pint..	1
Bread	ounces..	6
Butter	ounce..	½
Fish hash, with vegetables	ounces..	6

Saturday.

Coffee	pint..	1
Bread	ounces..	6
Butter	ounce..	½
Mutton chops	ounces..	6
Fried potatoes	do....	3

[a] Fresh fruit may be substituted in season.

DIET TABLES—Continued.

ORDINARY DIET—Continued.

BREAKFAST—Continued.

Sunday.

Chocolate	pint..	1
Bread	ounces..	6
Butter	ounce.	½
Meat stew	ounces..	4
Fruit sauce	do....	3

DINNER.

Monday.

Vegetable soup	pint..	1
Beef, boiled	ounces..	6
Potatoes	do....	8
Pudding, with sauce	do....	4
Bread	do....	4

Tuesday.

Beef soup	pint..	1
Beef, boiled	ounces..	6
Fish, fresh	do....	6
Vegetables	do....	8
Bread	do....	4
Fruit	do....	4

Wednesday.

Mutton broth	pint..	1
Mutton, boiled	ounces..	6
Potatoes	do....	8
Rice pudding, with sauce	do....	4
Bread	do....	4

Thursday.

Soup, bouillon	pint..	1
Beef, roast	ounces..	6
Potatoes	do....	8
Bread	do....	4
Fruit	do....	4

Friday.

Vegetable soup	pint..	1
Meat stew	ounces..	8
Fish	do....	6
Bread	do....	4
Vegetables	do....	8
Fruit	do....	4

Saturday.

Barley soup	pint..	1
Mutton, boiled	ounces..	8
Bread	do....	4
Vegetables	do....	10

DINNER—Continued.

Sunday.

Soup	pint..	1
Beef, roast	ounces..	6
Potatoes	do....	8
Other vegetables	do....	4
Rice or tapioca pudding	do....	4

SUPPER.

Monday.

Tea	pint..	1
Bread	ounces..	6
Butter	ounce..	½
Fruit sauce	ounces..	3

Tuesday.

Tea	pint..	1
Bread	ounces..	6
Butter	ounce..	½
Fruit, stewed [a]	ounces..	4

Wednesday.

Tea	pint..	1
Bread	ounces..	6
Butter	ounce..	½
Cooked fruit	ounces..	4

Thursday.

Tea	pint..	1
Bread	ounces..	4
Butter	ounce..	½
Fruit pudding	ounces..	4

Friday.

Tea	pint..	1
Bread	ounces..	4
Butter	ounce..	½
Cold meat	ounces..	4

Saturday.

Tea	pint..	1
Bread	ounces..	4
Butter	ounce..	½
Rice, with sauce or sirup	ounces..	4

Sunday.

Tea	pint..	1
Bread	ounces..	6
Butter	ounce..	½
Mush and milk	ounces..	12

[a] Fruit may be substituted in season.

NOTE.—The tea and coffee prepared with milk and sugar.

The quantities of the articles of diet indicate them as they are prepared ready to serve.

The above table gives the four classes of solid constituents in substantially the following proportions: Nitrogenous or plastic material, about 140 grams; fat, about 62 grams; carbohydrates (starch, sugar, etc.), about 450 grams; and salines, about 26 grams, and with about 2,250 grams of water. Although these quantities are somewhat in excess of the estimates for "healthy adults at rest," they are none too great for convalescents in whom tissue metamorphosis is being carried on, not only in the interest of repair or present waste from use, but in the interest of repair of past waste from disease, a point which should not be overlooked in the construction of hospital dietaries. In making any change from the above, the substituted articles should be in such quantities and of such kinds as to furnish constituents equivalent to those of the articles replaced.

Oriental cooly immigrants as a class are frequently placed in quarantine in large numbers, and the problem of their subsistence is fortunately easily solved. Boiled rice and meat stew are their staple diet, and the daily subsistence requisition should be made on a basis of 1 bag of rice and 50 pounds of meat for 100 coolies.

QUARANTINE STATION MANAGEMENT.

A large modern quarantine station presents, as public institutions go, some very unique features. Being essentially an emergency institution, it is subject to alternate periods of idleness and activity. For weeks or even months the duties of the personnel of a quarantine station may be limited to the care and preservation of the buildings, machinery, and other equipment. Without warning these duties may be suddenly increased to include the care and treatment of a large passenger steamer infected with quarantinable disease. At such times the preparedness of a station is given a most severe test, and the organization of the station, suddenly changed or adapted to the new conditions, frequently does not appear to the greatest advantage.

A modern hotel or steamship, each entailing the housing and maintenance of many classes of people and the care of much machinery, is usually in constant activity, practically to the limit of its usefulness, so that once perfect organization is acquired, the routine practice or drilling of the employees, together with the constant use of the machinery serve automatically to maintain the said organization at a regular and normal standard. Should the hotel suddenly lose all of its guests, or the steamship be taken out of commission, the resumption of full activity would be necessarily attended by some confusion and the display of a certain lack of organization, even though the mechanical departments were in the meanwhile maintained in perfect working condition. That the maintenance even of the mechanical departments of either a hotel or a steamship on a working basis during a period of nonuse is a difficult matter, probably all hotel and steamship men will agree. The nonuse of machinery not only causes a deterioration in the machinery itself, but causes the employees operating the latter to soon forget their good "team work," which is so vitally necessary not only to the proper operation of any kind of machinery, but to the proper performance of any function. If a modern quarantine station could have infected vessels constantly arriving for treatment, the conditions of organization and preparedness would be ideal. The actual problem which confronts a quarantine officer is the maintenance of an institution during long or short periods of practical nonuse at such a state of efficiency and preparedness that he can on two hours' notice handle a passenger steamer, perhaps a large one, infected with quarantinable disease.

With such a problem confronting him, it may be said that the medical officer in command of a modern quarantine station must not only possess good professional qualifications, but executive ability, common sense, mechanical ingenuity, and tact as well.

Contributory to successful quarantine station management, the medical officer in command should have assistants with good pro-

fessional qualifications and men or attendants who are loyal, intelligent, and sober. A medical officer in command with good executive ability, quickly learning the qualifications and actual worth of his own men, and instinctively noticing the qualifications of "other people's" men as they are likely to apply to his own particular needs, applies the law, "the office seeks the man" and by degree replaces any inefficient men amongst his own complement with suitable men from "at large."

The duties to be performed on a quarantine station.—The duties to be performed on a quarantine station may be divided into those which should be performed daily, and those which should be performed when the station is in active quarantine work.

Daily duties.—The daily duties may be divided into—

First. The care, preservation, and repair of the boarding steamer.

Second. The care, preservation, and repair of the small boats.

Third. The care, preservation, and repair of disinfecting vessels.

Fourth. The care, preservation, and repair of the wharves.

Fifth. The care, preservation, and repair of buildings.

Sixth. The care, preservation, and repair of machinery.

Seventh. Miscellaneous duties.

The care, preservation, and repair of the boarding steamer.—The proper care, preservation, and repair of a boarding steamer depends almost entirely upon the efficiency of the pilot and engineer, and their ability to recommend for employment deck hands and firemen of equal relative efficiency. A sober, steady, towboat captain who keeps his vessel in a shipshape condition, and who runs her steadily and without avoidable mishap, will usually prove a suitable pilot for a quarantine boarding steamer.

The hours and general duty of a towboat are not unlike those of a boarding steamer, and it will usually be found that a towboat captain possesses the requisite amount of tact in maintaining dignified and amicable relations with the engineer and his forces.

The pilot should be held responsible for the care of the ship, exclusive of the machinery, the navigation of the ship, and the discipline on board. The engineer should be a man of steady and sober habits and should have an ocean-going marine license at least as "first assistant, ocean steamship," and also certified machine-shop service. He should not only be capable of making minor repairs to marine engines and boilers, but he should have some knowledge of electricity and electrical machinery. The engineer should also be able to make out specifications and estimates of necessary repairs and the materials required therefor.

The entire care and responsibility of the machinery should be vested in the engineer, and in matters relating directly to the condition of the machinery he should report directly to the medical

officer in command. Otherwise the engineer reports to the pilot and receives orders from him. The details governing the care and preservation of quarantine steamers are clearly set forth in the "Regulations for the care of quarantine steamers," published by the U. S. Public Health and Marine-Hospital Service.

The care, preservation, and repair of small boats.—The care of small boats at a quarantine station is very important. Unless small boats receive constant attention and repair they always look untidy and soon wear out. The tendency is strong on the part of the average boatman to paint rather than clean a boat. The result is a "caking" of paint on the sides with a resulting early decay of the planking. A rowboat should be cleaned daily and the condition of the planking, thwarts, rowlock, sockets, and oars noted.

The care, preservation, and repair of disinfecting vessels.—The care, preservation, and repair of disinfecting vessels may be considered under two heads, one being the care of the disinfecting machinery on board, and the other the care of the hull proper. The care of the disinfecting machinery on a disinfecting vessel is, for practical purposes, set forth further on in the section devoted to the care of disinfecting machinery in general.

The hull of a disinfecting vessel, on account of the wear and tear incident to its being frequently moved to and from vessels or wharves, requires constant watching and repair. The copper sheathing is frequently torn in places or becomes detached, the chain ports become loose from rust, the bits may become loose from the same cause, the bilge pump exhaust pipes may become clogged, allowing water to remain in the hold, which soon becomes foul and boggy. The calking of the hull planking may become defective. The deck is subject to great wear and tear from the handling of trunks and sulphur, and the superstructure is frequently damaged by the projecting spars of vessels. Disinfecting vessels on account of the heat of the boilers, sulphur furnaces, and disinfecting chambers usually suffer from warping of the timbers of the superstructure, and are on the whole constantly in need of retouching with paint, not only on account of the heat generated within, but on account of the elements without.

The care, preservation, and repair of wharves.—The care, preservation, and repair of wharves includes the care of dolphins, mooring piles, straight and bracing piles, iron work, and floor timbers.

Dolphins should be watched carefully to detect for immediate repair any damage to the copper sheathing. Mooring piles are apt to wear and splinter at their points of protrusion through the floor of the wharf. This may be prevented by chocking and cleating. Straight and bracing piles, on account of the leakage of water from the wharf proper, soon become at first boggy and then rotten at their upper ends. This may be prevented by carefully calking the planking

just above the piles, and by the frequent application to the piles near the cap of boiling tar. Iron work used in the construction of a wharf, either in the form of girders, braces, or bolts, undergoes a constant rusting process. Such iron work should be inspected carefully once a month, and all rusting areas chipped with a chipping hammer, covered over with red lead, and then given a coat of ordinary lampblack and oil. The floor timbers of a wharf should be given especial attention. The dragging of heavy objects, such as trunks and chests, should be forbidden, and the tendency to splintering should be counteracted by the application of boiling tar.

The care, preservation, and repair of buildings.—Quarantine station buildings as a rule deteriorate rapidly from two distinct causes. First, their lack of steady occupancy and use, which usually ensures to buildings the normal amount of care where decent people are concerned. Second, the fact that when said buildings are occupied the occupants are apt to be a class of people who, whether through a natural resentment at being held under surveillance, or through sheer ignorance, have little or no regard for law and order. For instance, it is not uncommon during the daily inspection of the quarters occupied by people of the immigrant class, or even of classes from whom much more might reasonably be expected, to find windows broken, doors sprung, locks broken, plumbing destroyed and stolen, and walls defaced by the carving or writing of names or obscene rhymes, etc

The wire window, door, and ventilator screens, which must be necessarily kept intact if quarantine station buildings are to be maintained in a vermin-proof condition, frequently need repairing.

Quarantine station buildings, because they are usually located near the water, where they are frequently exposed to salt water spray or mist, require frequent painting.

The care, preservation, and repair of machinery.—The machinery of a quarantine station usually consists of steam disinfecting chambers, sulphur furnaces, fans, and engines, water and bichloride pumps, hoisting engines, and autoclaves. In addition there are boilers, fire extinguishers, and a steam laundry plant.

Steam disinfecting chambers.—The steam chambers should be frequently inspected for rust both on their outer and inner surfaces. All rust spots should be rubbed down to the metal with fine emery cloth, then painted with red lead. The greater part of the outer surface, which is usually covered with asbestos, should be kept perfectly white and clean. In tightening the iron doors at either end, care should be observed in not unduly compressing the rubber gaskets, and the latter should be kept covered with graphite. All steam-pipe connections should be kept perfectly tight. After using the formaldehyde attachments, steam should be run through the pipes and cylinders. Care should be taken to let out the water, which results from

the condensation of the steam, in the jacket of the chamber after using the latter.

The sulphur furnaces.—Owing to the excessive and variable temperatures to which the sulphur furnaces are subjected, the latter are apt to be constantly more or less rusty. The outer and inner surfaces should be frequently scraped, wiped off with mops soaked in kerosene oil, and then painted with lampblack and oil. The sulphur pipes should be so arranged that the elbows are easily detachable for scraping and painting.

Flexible sulphur hose should be suspended in wide canvas slings, otherwise it is liable to bend and crack.

The sulphur fans and engines.—The sulphur fans should be scraped and cleaned at least once a month. The sulphur engines require little attention and repair save sufficient lubrication.

Water and bichloride pumps.—After using the bichloride pump it should be washed out thoroughly with fresh water. The condition of the steam and water cylinder packing should be given regular attention, and renewed if necessary. The piston rods and valve shafts should be kept bright and well oiled.

Hoisting engines.—These usually give very little trouble and usually require only enough care to prevent the accumulation of rust.

Autoclaves.—Autoclaves require constant and careful attention. The Primus lamp pump should be kept well packed, and fine wire should be always kept in the holes in the burner jet. The valves of the autoclave proper should be kept in order and the casing painted occasionally with graphite paint.

Boilers.—Boilers, if covered with asbestos, should be painted white or yellow; if left unprotected they should be kept free from rust and painted with lamp black and oil. Boilers should be washed out frequently and "blown out" after using.

Fire extinguishers.—Fire extinguishers should be discharged at least once a month at fire drill and then recharged. The rubber gaskets in the crown and the washers in the spigots are apt to harden unless they are carefully watched.

The steam laundry plant.—A steam laundry plant requires much attention if it is to be kept free from rust. The moving surfaces, pulleys, and pulley shafts should always be kept bright, and lubrication should be maintained.

Miscellaneous duties.—The station day begins at 6 a. m., and ends at 5 p. m. The station night begins at 5 p. m. and ends at 6 a. m. The day hours may be as follows: 6 a. m., turn out all hands; 6.30 a. m., breakfast; 7 a. m., muster, at which general and special orders for the day are read, and assignments for duty made; thirty minutes are given for putting quarters in order; 7.30 a. m., work begins; 11 a. m., quick inspection; 11.45 a. m., work ceases—preparations are

made for dinner; 12 m., dinner; 12.45 p. m., work resumed; 4.45 p. m., work for the day ceases; 5 p. m., supper; 6 p. m., night watch reports for duty and orders. The raising and lowering of the station flag should be assigned as special duty. At 11 o'clock the quick inspection is made to determine the exact status of the station from a standpoint of discipline, cleanliness, and repair. When the quarantine station is in active operation with quarantinable disease on hand and people in detention, the station day proceeds as usual, only a larger or smaller number of attendants are given such special duty in such special hours as the conditions warrant, and a temporary or sub-organization is devised to fulfill the requirements.

OUT-GOING QUARANTINE.

Through the process of "out-going" quarantine a quarantine officer may protect other ports from quarantinable disease which is present in the port where he is stationed or in the territory contiguous thereto. This work consists of the certification of passengers, baggage, and freight, the disinfection of vessels, the inspection of vessels as to their conduct after disinfecting, the proper mooring of vessels not requiring disinfection, and the disinfection of wharves.

Passengers and crews are required to report at the quarantine office and furnish satisfactory evidence as to their place of residence, and according to their status, are either given a permit to embark without disinfection of baggage, or are first required to deliver their baggage for disinfection, the permit being given after the quarantine examination is made. The names, with places of residences, are made into duplicate lists for a final inspection immediately before the sailing of the vessel, and the lists containing all information sealed and forwarded as part of the ship's papers. After its disinfection all baggage is held until just before the sailing hour and is then delivered aboard the steamer. Yellow labels, marked "disinfected," are placed on each piece of baggage disinfected. The hull of a vessel must either be disinfected or properly guarded against the necessity therefor. In other words neither passengers nor baggage are certified as safe if they are to be transported in a suspected or infected hull. All freight orders must be examined, the safe articles viséed and those considered dangerous either disinfected or rejected.

The disinfection of baggage and vessels is carried out according to the United States quarantine regulations.

FIG. 14.—A BIRD'S-EYE VIEW OF A SMALL NATIONAL QUARANTINE STATION.

MARITIME QUARANTINE EQUIPMENT.

MARITIME QUARANTINE EQUIPMENT

Shore Quarantine Institutions.

Shore quarantine institutions are divisible into, first, inspection stations; second, shore quarantine stations.

INSPECTION STATIONS.

Inspection stations are maintained at certain designated points where vessels are subject simply to inspection to determine their sanitary status, being given free pratique if entitled thereto, or remanded to the nearest shore quarantine station for treatment if found either infected with or suspected of being infected with quarantinable disease. The ports at which the quarantine equipment is limited simply to inspection facilities are either those not far distant from a complete quarantine station or those wherein the commerce is too small to justify the maintenance of a complete quarantine station. For example, the ports of San Francisco and San Diego in California are equipped with complete quarantine stations, while the ports of Monterey, Santa Barbara, Los Angeles, San Pedro, and Newport, all of which are located on the Pacific coast between San Francisco and San Diego, are provided simply with inspection facilities. In the event it is necessary to remand a vessel to a quarantine station for treatment, either San Francisco or San Diego may be used as a port of refuge, a choice of ports being determined by the distance to be traveled.

SHORE QUARANTINE STATIONS.

The selection of a site for a shore quarantine station.—The site on which a quarantine station is to be built should be well adapted for the peculiar purposes for which it is to be used. Indeed the practical value and public utility of a quarantine station depends largely upon the degree to which the site approaches ideal conditions. An ideal site combines natural isolation, convenience to recognized harbor channels, and close proximity to a protected deep-water anchorage. By the term natural isolation is meant the barriers formed by the topography of a place, such as precipices, ravines, and streams. For example, a tongue-shaped peninsula jutting from the base of a

high hill or precipice into deep water would constitute a practical and ideal mainland quarantine station site with natural isolation. A small island, located within harbor confines and not far removed from the mainland, is frequently available for quarantine station purposes, and can usually be made suitable. Such a site exemplifies clearly the term, and fulfills the conditions, of natural isolation. Convenience to recognized harbor channels is an important consideration in the selection of a site for a quarantine station, because in requiring vessels to proceed to a quarantine station located a great distance away from the inspecting anchorage considerable hardship may be imposed upon sailing vessels on account of necessarily large towage bills and upon steamers on account of the loss of valuable time.

The third condition, that of close proximity to protected deep-water anchorage is very important, both on account of the necessity of sufficient depth of water and of protection from heavy winds and waves. The minimum depth of water required for the largest ocean carriers is 34 feet, therefore an anchorage with less depth will not be a safe one for a deep-draft vessel. Protection from heavy winds and waves is absolutely essential in an anchorage at a quarantine station. Frequently sailing vessels bring ballast which, if consisting of either loam, sweepings, or mud, it may be necessary to discharge in quarantine. Unless the vessel be anchored in a place protected from heavy winds, she will be in danger of capsizing after the removal of ballast or even during the process of removal. It is true ballast logs may be fastened on either side of a vessel to prevent mishap under such circumstances, yet their absolute safety is extremely doubtful. Protection from excessive wave motion is just as essential as that from exposure to the wind, as the former will prove an obstacle to the safe handling of vessels while they are being placed alongside the quarantine station wharf, as well as a source of danger to the wharf itself. Even small boats are subjected to great wear and tear by excessive wave motion.

The last two conditions, convenience to recognized harbor channels and close proximity to protected deep-water anchorage, if lacking, may be overcome by structural devices or executive measures, but the condition of natural isolation, if lacking, is almost certain to bring the public safety and therefore the integrity of quarantine as a principle into jeopardy. To effect the requisite isolation at a quarantine station where it is not already provided by nature, recourse must be had to some form of personal restriction, which measure is unreliable and to say the least is undesirable. The area of a quarantine reservation should comprise at the least 5 or preferably 30 acres of land. A gentle slope on a rocky subsoil is very desirable, and a good water supply a positive necessity. The num-

FIG. 15.—A QUARANTINE STATION HOSPITAL WITH ISOLATION BUILDINGS.

ber and size of the trees should be limited to insure moderate protection from the glare of the water. For the comfort of the officers and men who are to reside at a quarantine station, as well as for that of the people who may be detained there, the mean velocity and direction of the wind are points which should be carefully considered in the selection of a site. A wind-swept quarantine station is a dreary spot even for temporary residence, is difficult to administer, and is always in need of more or less repair in consequence of the effect of the wind. If a small island be not available, it is wise to select a suitable site on a salt-water marsh, if one can be found fulfilling the three conditions of natural isolation, convenience to recognized harbor channels, and close proximity to protected deep-water anchorage. The cost of construction upon a salt-water marsh, however favorably located the marsh may be, is always great, and in the selection of such a site the advisability of building a floating plant should be well considered before a decision is arrived at. In places where neither small islands nor salt-water marshes are available a site must be selected on the mainland. In the selection of a quarantine station site on the mainland it is absolutely essential that at least the condition of natural isolation be fulfilled. It is usually extremely difficult to get a proper quarantine station site near a large city, therefore it may become necessary to build a flotilla quarantine plant. This is always advisable when a contemplated mainland site is likely to prove inadequate to the peculiar purposes for which it is intended.

THE GENERAL ARRANGEMENT OF BUILDINGS ON A QUARANTINE STATION.

For the proper administration of a quarantine station there must be a schematic arrangement of all the buildings or units into natural groups or departments. These departments are designated as follows: First, the executive department; second, the disinfecting department; third, the mechanical department; fourth, the pathological department; fifth, the first cabin passenger department; sixth, the second cabin passenger department; seventh, the military department; eighth, the steerage department.

The executive department.—This department comprises the executive building, quarters for commissioned and noncommissioned officers, and the attendants' barracks. This group of buildings or department should be located on a site as far as possible removed from the remainder of the station buildings. The executive building should contain the administrative offices and the pharmacy. It should be comfortable in its arrangement and if possible tasteful in design. On a small quarantine station where economy is a special consideration, the medical officer's quarters and the executive offices may be

included in one building. The quarters for commissioned and noncommissioned officers should be constructed with a view to local needs and conditions. Above all things they should be comfortably but inexpensively arranged and appointed.

The attendants' barracks should consist of a single building varying in size with the number of attendants to be accommodated. The rooms should open into a very wide central hall. This hall may be used by the attendants as a lounging place or club, or as an improvised gymnasium. Too much care can not be observed in providing attendants with suitable quarters, as life on a quarantine station is frequently tiresome and uneventful, and it is necessary to maintain as much esprit du corps as possible by an arrangement of quarters tending to sociability and good fellowship.

The disinfecting department.—This department includes the disinfecting warehouse and its contained disinfecting machinery and appliances. The disinfecting warehouse is always located upon the quarantine station wharf if the station is provided with a wharf. Where the station landing facilities are limited to a small platform or boathouse, the disinfecting warehouse is located at a suitable place on the quarantine station reservation. A disinfecting warehouse must be equipped to perform two quarantine functions. One of these functions is the disinfection of vessels, another the disinfection of personal and miscellaneous effects. For the performance of these functions the machinery and general equipment should be so arranged in the warehouse that almost perfect unison in operation is attained.

For the disinfection of a vessel sulphur furnaces, sulphur pots, large and small, formaldehyde autoclaves, and carbolic acid and bichloride of mercury solutions are provided. The sulphur furnaces, preferably two or four in number, are arranged about the center of the wharf on a trestle 10 feet high. On the same trestle but at a still higher elevation should be placed two 2,000-gallon tanks, one for carbolic acid solution and the other for bichloride of mercury. A number of iron pots and galvanized iron tubs, some large for the disinfection of big compartments, and many small ones for the disinfection of staterooms, should be kept ready for use near by. On the trestle to the rear of the sulphur furnaces a sufficient supply of sulphur is kept ready for use. For the disinfection of personal effects, steam disinfecting chambers, with formaldehyd generators attached, should be located in the center of the warehouse. These chambers are made to project on either side of a central partition which divides the "infected" room from the "disinfected" room. A checking room for the safe-keeping of valuables should be maintained in the disinfecting warehouse.

FIG. 16.—A QUARANTINE STATION HOSPITAL WARD.

FIG. 17—A QUARANTINE STATION LABORATORY

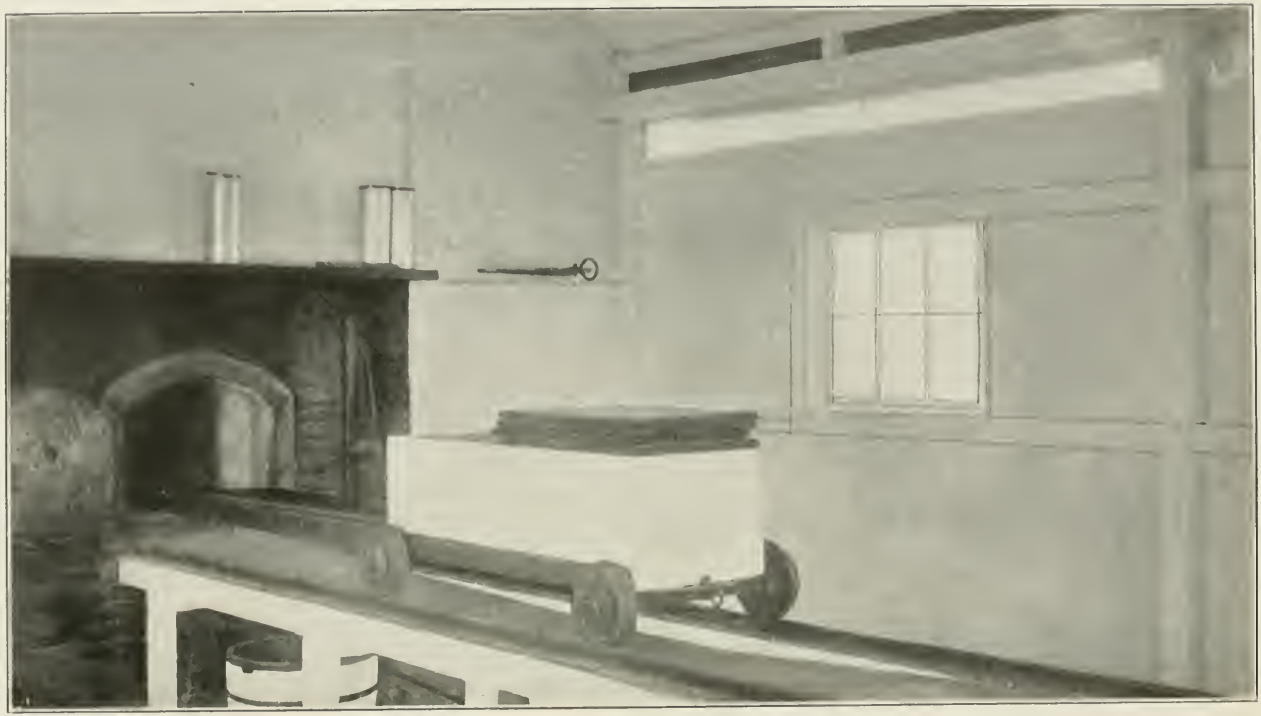


FIG. 18.—THE INTERIOR OF A QUARANTINE STATION COMPOSITE NECROPSY ROOM AND CREMATORY

The mechanical department.—This includes the steam laundry and the artificers' workrooms. Every large quarantine station should be provided with a suitable steam-laundry plant. The machinery should be selected with some reference to the prevailing climate of the port wherein the quarantine station is located. For instance, drying chambers are useless in the Tropics where there is usually an abundance of sunshine, but absolutely necessary in a climate where foggy weather prevails.

The artificers' workrooms comprise the carpenter shop, paint shop, machine and plumber shop. This division is all important to a quarantine station, because emergency repairs are constantly necessary, and the good general preservation of buildings and equipment can not be maintained without a well-conducted artificer shop.

The pathological department.—The pathological department comprises the quarantine hospitals, the bacteriological laboratory, and a composite autopsy room and crematory. This department as a whole should be located as far as possible from the other departments and at the same time to the leeward of them.

The quarantine hospital should be divided into two bed wards or units, wherein the sick may be separated according to their class, sex, and disease. One or more of these units or small wards may be used at any time for purely isolation purposes. It is more desirable, although more expensive, to separate the units by open passages or even to construct them as small detached cottages. Practical experience will show the large wards to be ill adapted for the treatment of persons suffering from quarantinable disease, and such wards will ultimately become obsolete. These cottages or units should be eight in number for an average quarantine station, and should have as accessories a small bath house, a small kitchen, and a cottage for two orderlies. They may be constructed of lumber, but in their construction the following points are essential:

First. The cottages should be raised on an average at least 2½ feet from the ground.

Second. The studding should be built on the outside of the siding, the inside lining being closely approximated to the latter. This makes a double-wall cottage without dark spaces, or in other words, a vermin-proof building, between the walls of which there are no spaces capable of accommodating even the smallest of vermin.

Third. The windows should contain only one sash and be made to swing on hinges to the inside.

Fourth. The windows should be protected by fine-mesh bronze or brass mosquito wire screening on the outside, and each door should be provided with an insect vestibule.

Fifth. Portable or roller bath tubs and enameled pail commodes should be provided in order that the disinfection of bath water and excreta may be effected.

Sixth. Each window and door should be provided with rubber stripping or weather strips which serve the two purposes of making rooms practically air-tight and vermin proof and therefore easy of disinfection.

Seventh. All hardware should be of brass or composition bronze.

The morgue and crematory.—These very necessary adjuncts to a properly appointed quarantine station had best be built so that the crematory will be closely connected with and convenient to the morgue. The crematory may be a very simple and inexpensive reverberatory hearth. The hearth should be about 3 feet wide and 7 feet long. The vault should be arched, the arch commencing at its junction with the side of the hearth to reach a height of 2½ feet. The fire box is located at one end of the hearth and from the other end the vertical flame shaft leads to the chimney. The opening of the furnace is provided with an ordinary cast-iron door, through which the body is rolled on a car especially constructed for the purpose. This car runs on tracks mounted on a light trestle which stands 3 feet from the floor and which also serves as an autopsy table prior to the rolling of the body along the trestle into the crematory furnace.

The autopsy room and the crematory proper should be separated by a partition. The materials used in the construction of the crematory and autopsy building should be corrugated-iron roofing and sides, on a frame of 2-inch iron piping. The furnace should be constructed of vitrified brick and the whole encircled with iron bands. The hearth and fire passages should be lined with regular fire brick.

The chimney should be built of brick, should have a height of at least 30 feet, and should be provided with a damper. Wood is a very good fuel for the simple hearth just described, and, although it is somewhat more expensive to use, is economical in the long run, as it does not burn out the hearth, vault, and chimney to the extent that coal does.

The bacteriological laboratory should be small and compact and appointed simply for diagnostic purposes. A small animal barn is a necessary adjunct to any quarantine station. Guinea pigs, rabbits, and rats should always be kept on hand.

The first-cabin passenger department.—The detention quarters for first-cabin passengers must furnish a degree of comfort at least comparable with that which commonly falls to the lot of passengers of this class when afloat.

The easiest way in which to house cabin passengers is by the construction of buildings containing twelve small rooms arranged on either side of a central general partition. The rooms should measure 10 by 15 feet at the sides, with ceilings not more than 10 feet from the floor. Such rooms should accommodate two persons. On either side of the building a large wide porch should be provided. A build-

FIG. 19.—A FIRST-CABIN PASSENGER DETENTION BUILDING.

FIG. 20.—BUILDING FOR DETENTION OF SECOND-CABIN PASSENGERS.

FIG 21.—TYPE OF BUILDING USED FOR THE DETENTION OF ORIENTAL STEERAGE PASSENGERS AND CREWS.

ing such as the one described will accommodate from forty-eight to sixty persons. One or more of such buildings may be provided, as necessity demands. It may be said on general principles that for the average port there should be quarantine detention facilities for at least one hundred first-class passengers. There should be a four-bed or four-room hospital for the accommodation of persons in the first cabin suffering from nonquarantinable disease. The kitchen and dining rooms should be in separate buildings in order that the hazard from fire may be decreased and administration made easier.

The second-cabin department.—The quarters for second-cabin passengers should consist of one-story cottages or units containing six rooms on either side of a central partition. Large porches should be provided as in the case of the quarters above described for first-cabin passengers. The rooms may be 15 feet square, and the building as a whole should accommodate forty-eight persons. The number of such units or buildings required on the average quarantine station will be about four. The rooms should be equipped with folding iron enamel bunks. The bath houses, water-closets, and kitchen should be separate.

The steerage department.—This department is a very important one on all quarantine stations. It is probable that nine-tenths of the quarantinable diseases occur either in the steerage passengers or in the crew of a vessel. At certain quarantine stations the problem of caring for or detaining steerage passengers is an exceedingly simple one. At those ports in direct communication with the Orient the steerage passengers as a class are apt to be composed of persons of many different nationalities. Therefore the steerage detention department of such quarantine stations must be built and conducted as far as possible in accordance with these peculiar conditions. The most practical steerage detention department consists of a long building, which with its auxiliary structures is built around a hollow square. All spaces between buildings are closed by means of high picket fences and ingress or egress is confined to one large central gate. The long building is divided into quarters for various nationalities and further subdivided for the sexes. The bath houses and latrine sheds should be distinctly separate. The kitchen should occupy a central position in the hollow square in order that the distribution of food may take place from all four sides of the building. In the compartments used by the Orientals the sleeping accommodations should consist of low raised platforms on which mats may be spread. The Oriental prefers sleeping on such a platform to the use of an ordinary bed. The platforms should be made of surfaced material and should be kept well painted. For Orientals large bath tubs are necessary. These may be constructed of wood and let into

the ground, or built on the floor of the house in the regular manner. A limited number of showers may also be provided, as these are coming into use by the Orientals. A constant supply of hot water is an absolute necessity in the steerage department. The latrines should consist of long zinc-lined troughs constructed so as to admit of the disinfection of the excreta before it is discharged into the sewer mains. Every device which ingenuity suggests should be employed to protect steerage passengers, particularly Orientals, from mosquitoes and vermin. While no one general plan or system of construction will accomplish the result, a combination of screening on the vestibule plan with the help of pyrethrum powder will solve this problem as a general rule.

Military department.—A department for the handling of large bodies of troops is necessary in those ports which are along the routes usually traversed by military transports It is not an unusual thing for a transport to carry 1,500 troops, therefore it is reasonable that some accommodations be provided at certain quarantine stations for at least that number. A quarantine military camp need only be maintained in skeleton form. It should consist of wooden tent floors arranged in company streets, with the latrines well off to the leeward and the cook houses located well to the windward. There should be sufficient water supply, and this should be piped to a point convenient to the tent floors. The tent floors should measure 14 by 15 feet in order to accommodate an ordinary military hospital tent. For quarantine purposes such a tent will hold eight soldiers. Canvas cots should be issued, as these are easily stowed away and kept clean. The cook houses should always be ready for the reception of the portable cook ovens, or else regular ranges should be built into the cook houses. The latrine houses should be equipped with long zinc-lined troughs wherein excreta is disinfected prior to discharge into the sewer mains.

GENERAL SUGGESTIONS GOVERNING THE CONSTRUCTION OF QUARANTINE-STATION BUILDINGS.

Two of the most important quarantinable diseases, yellow fever and plague, are disseminated through intermediate hosts. The intermediate host of yellow fever is the Stegomyia calopus mosquito, an insect abounding in most tropical or semitropical countries. The intermediate hosts of plague being vermin, especially rats and their fleas, it is essential, therefore, that every endeavor should be made to prevent mosquitoes and vermin from effecting an entrance to quarantine-station buildings. It is equally essential that the propagation of insects and vermin be made impossible by definite structural schemes and scrupulously careful policing. Invading insects or vermin, like invading armies, are most effectually combated when

the area or country invaded is rendered uninhabitable. In rendering quarantine-station buildings uninhabitable to the above-mentioned intermediate hosts it is essential that there should be no dark spaces in the houses or between their walls, and no permanently damp or wet places near the houses. In other words, vermin-proof construction must be carried out completely in buildings on quarantine stations, and the grounds of these quarantine stations must be graded so as to make permanently damp places an impossibility. In a vermin-proof house all spaces or intervals between the walls are obliterated by the close apposition of the outer and inner walls, the studding or framing being left exposed either on the outside of the building or on the inside of the rooms. The two layers of flooring, even in the case of a two-story building, being likewise placed in close apposition and laid on exposed cross beams or joists. Therefore, in a vermin-proof structure either insects or vermin are easily visible, as they may be found either on the inside or on the outside of a house, but never between anything. This vermin-proof construction is not expensive, and when interiors are finished in natural color the effect of the exposed studding and overhead rafters is pleasing, not to say attractive. In constructing the roof an interval should be left between it and the ceiling of the rooms, said interval being protected on all four sides of the building by wire-gauze screening.

All piping and wiring must be left exposed or else run through removable shafts. Every house should be built at a mean elevation of 3 feet from the ground, and the soil underneath should be tamped hard and lightly covered with whitewash or lime in order that a white surface may be provided which will reflect the light and disclose at once the presence of any object requiring removal. The construction of the side walls of the vermin-proof house only admits of the use of the single square hinged windows. These should be 3 feet square and made preferably with small diamond window panes. The window jambs should be reinforced by rubber stripping, which, acting as gaskets when the windows are closed, renders the room air-tight for proper disinfection. The door jambs should be similarly arranged with the same object in view. All doors should be protected by bronze wire-screen vestibules and all windows by wire screening immovably fastened to the window frame on the outside of the building. The plumbing should be centralized as much as possible, all pipes being grouped within a short radius. This permits the easy inspection of the plumbing to detect defects and facilitates making repairs when such are necessary. All rooms should be provided with small screen-protected openings or square ports placed near the ceiling in the side walls. Such openings or ports should be provided with hinged doors and rubber stripping in order that they may be closed and rendered air-tight when occasion requires. These

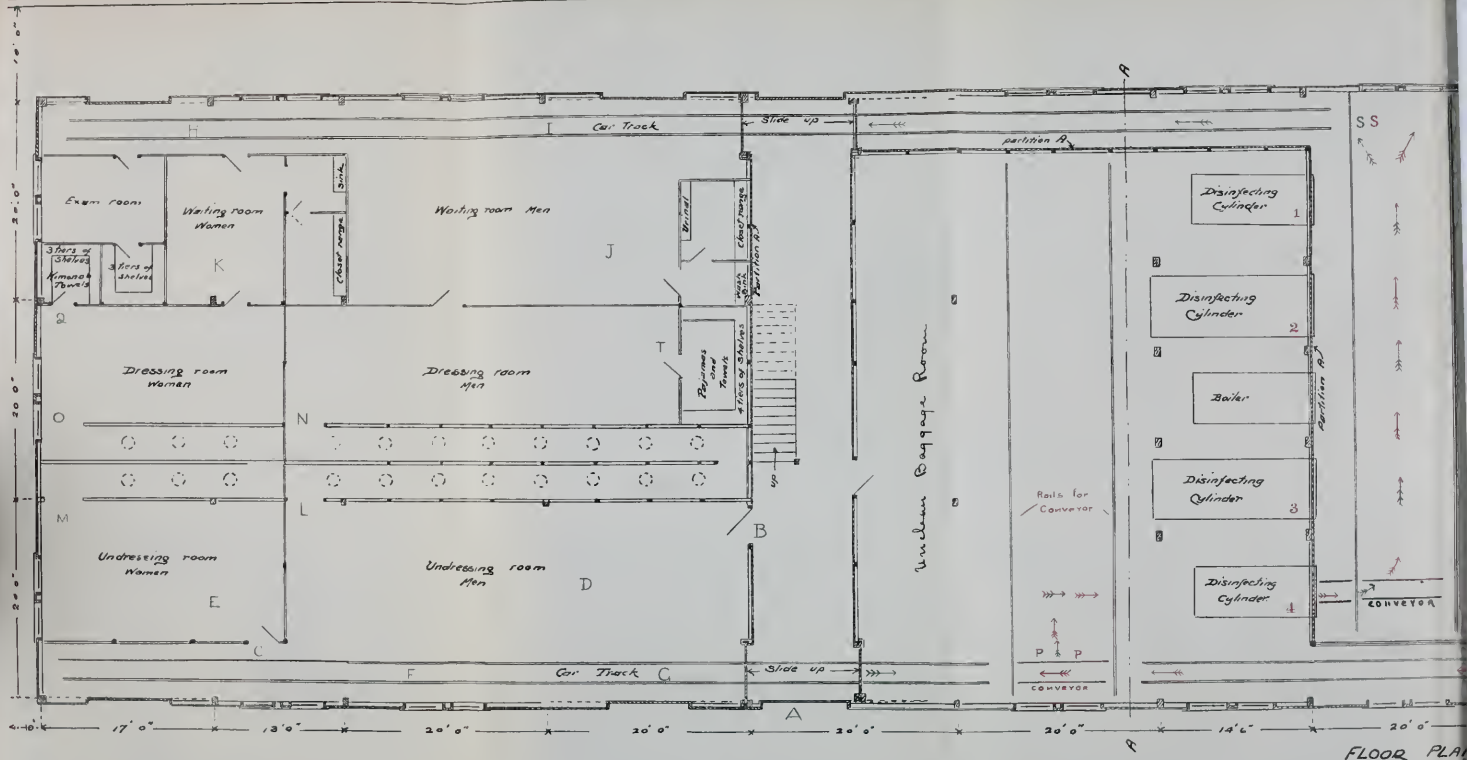
openings are both useful and efficient for ventilating purposes in tropical countries, where frequently on account of wind and weather the proper ventilation can not be maintained by open windows and doors.

Trees and shrubs should not be planted within 10 feet of any building on a quarantine station, and no trees or shrubs with large leaves capable of holding water or maintaining moisture should be allowed on the reservation. In other words, an area likely to be invaded by the intermediate hosts of the various quarantinable diseases should be rendered as nearly as possible uninhabitable for them.

DISINFECTING WHARVES.

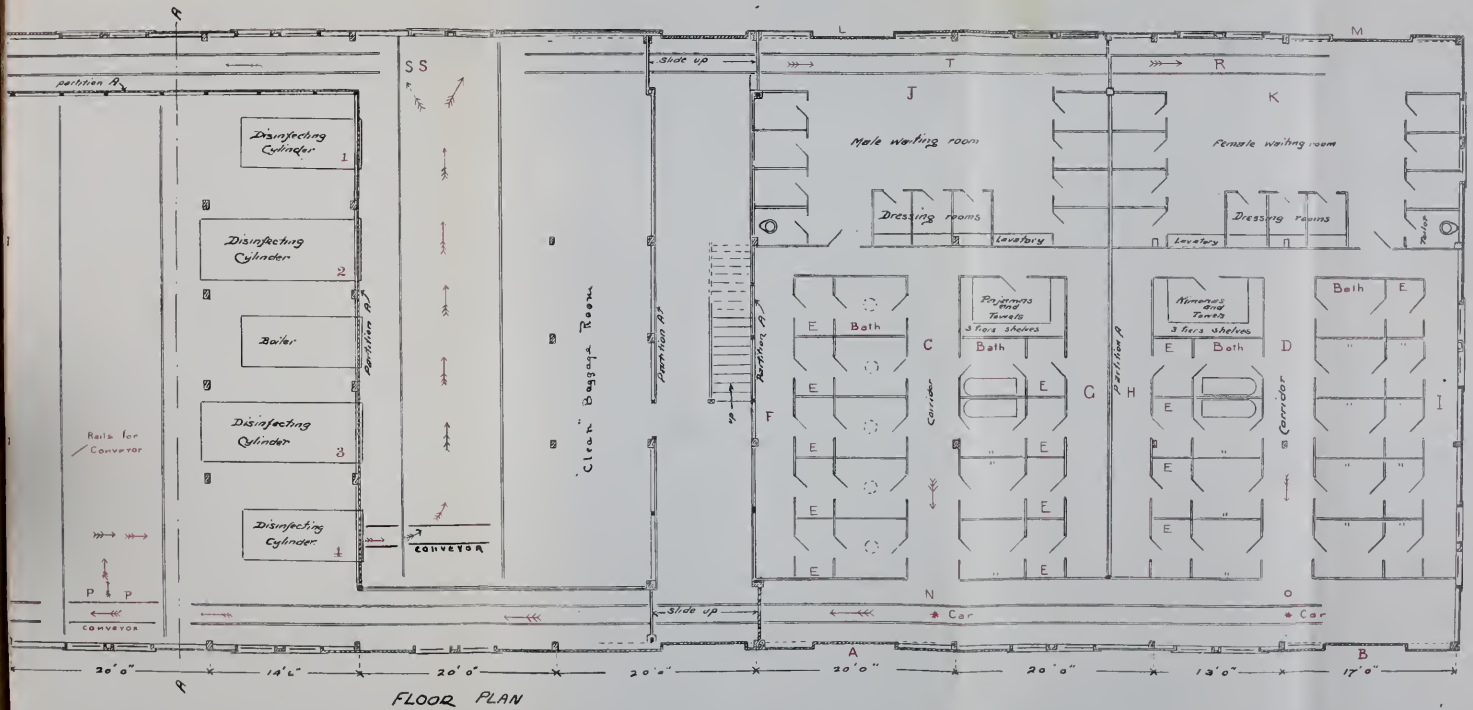
A disinfecting wharf is arranged especially and exclusively for the fumigation of vessels and the disinfection of baggage and freight. Figure 22 shows the floor plan and general arrangement of a disinfecting wharf superstructure. In this drawing the dressing, waiting, and bath rooms, and the steam disinfecting chambers are shown. The sulphur furnaces and the bichloride and carbolic-acid tanks are mounted on trestles at a higher level over the steam disinfecting chambers.

Steerage passengers are taken from the gang plank of the vessel through the opening A, after which the men and women pass through the openings B and C into the men's and women's undressing rooms D and E. The disinfecting cars are standing in readiness at the points F and G to receive the clothing after it has been placed in wire cages and checked. After the clothing is loaded onto the cars, the latter are rolled to the right to the point P, thence to the left on the conveyor, thence through the disinfecting chambers, thence to the left along the "clean" conveyor to the point S, thence to the left to the points H and I in the waiting rooms J and K. The clothing is then unloaded and returned to the passengers, who, having had their baths, are waiting for their clothing in the waiting rooms J and K. While the clothing is going through the process above described the passengers, having disrobed, enter the shower-bath alleys at the points L and M, and, after walking through the continuous water jets emerge at the points N and O, proceed to the kimono and towel rooms Q and T. After drying and clothing themselves with the kimonos, they enter the waiting rooms J and K and exchange their checks for their baggage, which is waiting on the disinfecting cars at the points H and I. Attention is called to the arrangement by which the "clean" and "unclean" divisions of the steam chamber department are separated by the bulkhead Q and R through which the "clean" ends of the steam chambers project. On the right, overhead, one of a series of three bichloride and carbolic tanks may be seen. The sulphur furnaces are located in the positions marked X and X′.



FLOOR PLA

FIG 23.—FLOOR PLAN OF QUARANTINE WHARF SUPERSTRUCTURE


Partition A
Disinfecting Cylinder 1
Disinfecting Cylinder 2
Boiler
Disinfecting Cylinder 3
Disinfecting Cylinder 4
Rails for Conveyor
P P
Conveyor
SS
Conveyor
Clean Baggage Room
Partition A
Partition A
Slide up
Slide up
Partition A
T
R
L
M
J
K
Male waiting room
Female waiting room
Dressing rooms
Lavatory
Dressing rooms
Lavatory
Partition A
Partition A
Partition A

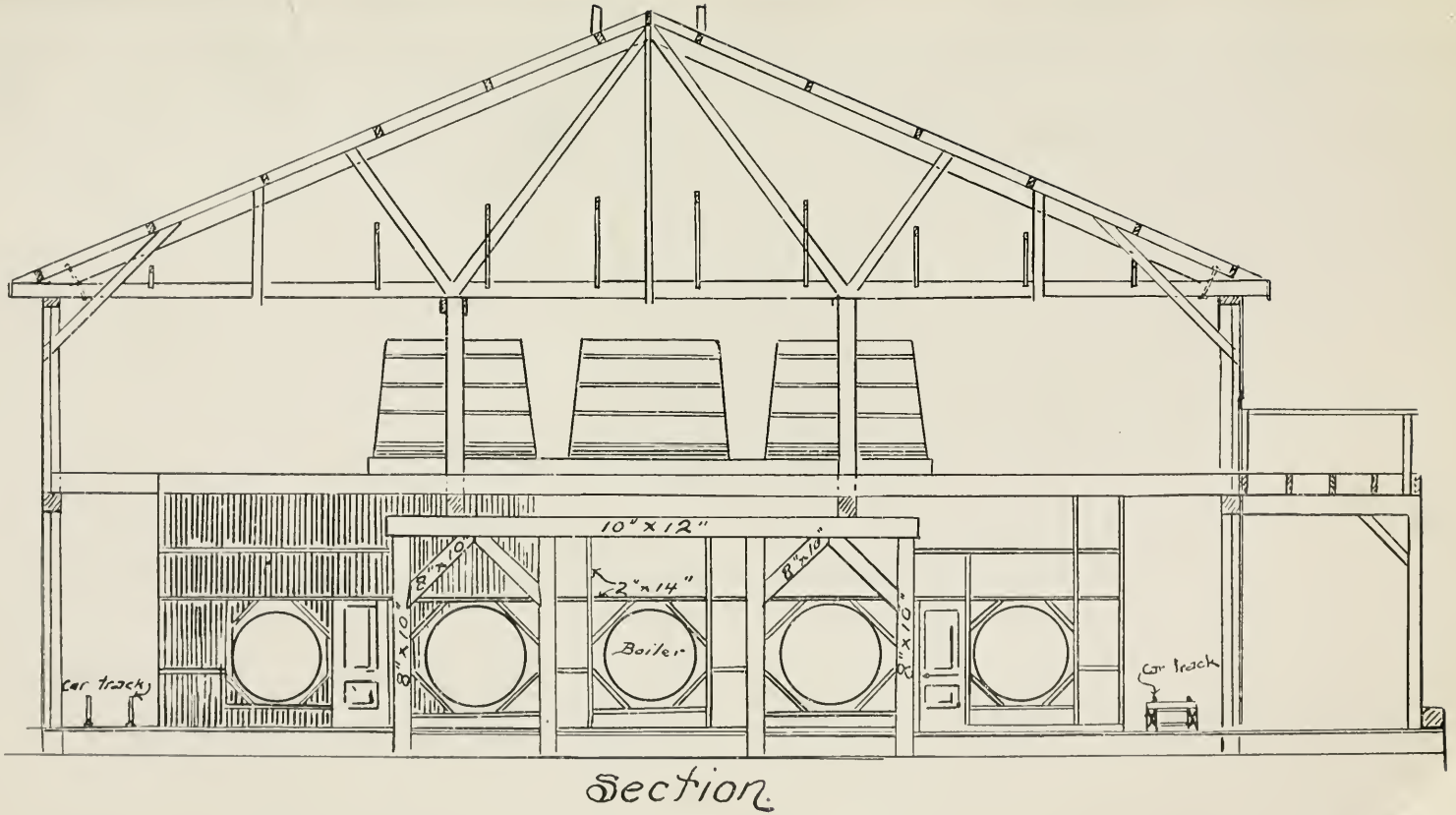


FIG. 23.—CROSS-SECTION THROUGH A QUARANTINE WHARF SUPERSTRUCTURE.

FIG 24.—A LAZARETTO SCOW

FLOATING OR FLOTILLA QUARANTINE PLANTS.

The floating quarantine plant is suggested for use in the small ports in the Tropics, where "way-port quarantine" with sea detention will at times replace the usual detention at quarantine stations at home ports. By way of illustrating "way-port quarantine" with sea detention, let us suppose that a large passenger and mail steamer should arrive at Honolulu en route to Yokohama with a case of plague on board. "Way-port quarantine" would simply consist of the removal of the sick and direct contacts and the disinfection of the vessel. The vessel would be held in quarantine while at Honolulu and no one would be allowed on shore, yet immediately upon the completion of the disinfection the vessel would be allowed to proceed to Yokohama, the ten days' time of the voyage being used as detention. Upon the arrival of the vessel at Yokohama the quarantine officer at that port would have for his consideration, in judging the sanitary status of the vessel, the facts of previous removal of sick and disinfection of persons and things at Honolulu, together with ten days of detention at sea. Where there is likely to be much way-port quarantine work, a small floating quarantine plant is both effective and convenient, but it is in the long run expensive so far as administration is concerned. In other words, a floating plant will almost invariably fulfill the general quarantine requirements of isolation and convenience to commerce, but it is, unfortunately, rather expensive to maintain.

In those ports where suitable sites for shore quarantine stations are not available, floating quarantine plants may be absolutely necessary. In any event before a shore quarantine site in a tropical port or a port liable to be infected with plague or yellow fever is selected, the question of the desirability of a floating quarantine plant should receive full consideration.

The advantages of the floating quarantine plant may be divided into those affecting vessels and those affecting quarantine administration. The advantages offered to vessels, especially the large ocean carriers, consist in the saving of time and trouble incidental to the taking of such vessels out of the regular channels to distant anchorages, which may not have sufficient depth of water or swinging room to insure safety either to the vessel itself or to the quarantine wharf alongside of which she must be placed. The advantages offered to quarantine procedure consist in the ease with which isolation is effected, the greater daily working capacity of a plant capable of being moved either in part or as a whole from one vessel to another, and the convenience of administration as compared with the expense of running a shore plant with the same working capacity.

A flotilla plant consists of a series of barges, scows, or hulks especially converted or adapted as the component units of a complete quarantine station. In other words, a flotilla plant consists of a disinfecting scow, a lazaretto scow, and the necessary passenger-detention barges.

The disinfecting scow should be 100 feet in length and 50 feet in width, and constructed to withstand the wear and tear which the frequent handling of a large scow always entails. The bottom should be coppered and the decks should be well seasoned, calked, and filled. The hold should be constructed so as to admit of complete ventilation and thorough cleansing. On the main deck a strong superstructure two stories high should be provided. On the cover or top deck of the superstructure the battery of sulphur furnaces, the boiler, and the disinfecting tanks should be placed. On the next deck below, the steam disinfecting chambers and the bathrooms should be located, and finally, on the lower or main deck, all of the room in the superstructure should be used as a passenger mustering or waiting room.

The disinfecting scow should also be equipped with automatic fenders, a steam winch, four good anchors, and a steam crane for hoisting baggage. The lazaretto scows should be two in number but very much smaller in size than the disinfecting scows. The length of such a scow need be only 50 feet, the breadth 40 feet. The character of construction should conform in a general way to that recommended above for the disinfecting scow. In its general appearance it should resemble a house boat, and be comfortably appointed. On the main deck there should be a superstructure consisting of two decks or stories. The top story or compartment should be devoted entirely to ward purposes. It should be equipped with special reference to the care and treatment of quarantinable diseases. The compartment below on the main deck should be subdivided into staterooms for nurses and cook, and galley and storerooms. All windows, doors, and other openings should be protected by bronze wire screening, and devices for rendering all compartments air-tight for proper disinfection should be provided.

A floating quarantine plant should never have less than two such lazaretto scows, for the reason that diseases such as plague and smallpox or cholera and smallpox if treated at the same time must necessarily be widely separated.

The detention scows should consist of two distinct units, one for the housing of second cabin and another for steerage passengers and crew. Obsolete sailing vessels or hulks may be used for detention purposes after suitable alterations are made and the proper appointments furnished. It is intended that the two classes of passengers should be given accommodations and care, while undergoing quarantine detention, of a kind similar to the accommodations accorded

FIG. 25.—A DISINFECTING VESSEL SIMULTANEOUSLY DISINFECTING TWO OTHER VESSELS.

their respective classes on passenger steamers. A flotilla quarantine plant should be furnished with mooring buoys placed in protected coves where access to shore will not be difficult, and where the disinfecting scow can be got at readily for immediate use when required.

DISINFECTING VESSELS.

A vessel or barge of any description, if equipped with disinfecting machinery, and possessing the requisite floor space for disinfecting baggage, may be called a "disinfecting vessel."

Disinfecting vessels may therefore be used in lieu of disinfecting wharves not only for disinfecting other vessels, but for disinfecting baggage. Such vessels, if large and completely appointed, are far more serviceable for quarantine work, especially in busy ports, than quarantine wharves, even if the latter are better equipped, the reason for this being the fact that usually a wharf can accommodate only one vessel at the time, while the disinfecting vessel, if placed between two other vessels, can do double work in the same length of time. Again, considerable time is necessarily lost in bringing a vessel to and taking it away from a disinfecting wharf, while a disinfecting vessel can be moved from vessel to vessel, perhaps disinfecting several vessels with the minimum of time and expense. Another important and practical use to which a disinfecting vessel may be put is the performance of municipal disinfection by placing the said disinfecting vessel alongside of any wharf, where it at once becomes for practical purposes a shore disinfecting plant.

The size of the vessel or barge determines its capacity for handling baggage. The unpacking and packing of trunks, valises, and the like requires a great deal of floor space, so that the capacity of a vessel for this purpose is governed more by the latter than by the number of steam chambers which may be placed on board. On the other hand, the capacity of a disinfecting vessel for fumigating and spraying with bichloride solution may be rendered very great with the use of a comparatively small deck area.

Disinfecting vessels may also be improvised from the hulls of obsolete schooners, or even from large coal or freight transfer barges. Before purchasing a barge or scow it should be seen that the timbers below the water line are in good condition. It is also essential that the bottom of the barge or scow be coppered. A barge should have a deck space of at least 22 by 90 feet, and a scow should have a deck space of at least 30 by 50 feet. The bichloride tanks, coal bunkers, fresh-water tanks, store and lock rooms should be placed in the hold, where they are out of the way and where their contained stores may serve as ballast. The sulphur furnaces, fan, and its engine should be placed overhead on the main deck, as every available foot of space on the main deck should be conserved for the steam chambers

and for the room required to properly handle baggage. A disinfecting vessel should be divided athwartships by a tight compartment, through which one end of each steam chamber should project. This divides the spar-deck space into an "infected" or receiving division, and a "disinfected" or discharging division. The after end should be the "infected" end. The bath and undressing rooms should be placed overhead, on the same level as the sulphur furnaces, but to the leeward of them. The bath and dressing rooms are arranged so that a passenger, having entered the small dressing room, undresses, and having placed his clothes into a marked wire cage or clean gunny sack, hands them to an attendant, who in turn passes the clothes below for disinfection, while the passenger enters the bathroom. After leaving the bathroom the passenger passes to the dressing room, receives a clean kimono or dressing gown, and there waits for the return of his clothing from the disinfecting chambers below. Disinfecting vessels should be constructed to insure easy and complete cleansing, and all interiors above the spar deck should be kept well covered with white enamel paint.

Appendix.

[From the United States Quarantine Regulations, 1910.]

DISINFECTANTS AUTHORIZED BY THE UNITED STATES QUARANTINE REGULATIONS AND THE PROPER METHODS OF GENERATING AND USING SAME.

PHYSICAL DISINFECTANTS.

151. Burning. Of unquestioned efficiency, but seldom required.

152. Boiling. Very efficient and of wide range of applicability. The articles must be wholly immersed for not less than ten minutes in water actually boiling (100° C.). The addition of 1 per cent of carbonate of soda renders the process applicable to polished steel, cutting instruments or tools.

153. Steam.

(*a*) Flowing steam (not under pressure). Flowing steam (not under pressure) when applied under suitable conditions is an efficient disinfecting agent. The exposure must be continued thirty minutes after the temperature has reached 100° C.

(*b*) Steam under pressure without vacuum. Steam under pressure will sterilize, provided that the process is continued twenty minutes after the pressure reaches 15 pounds per square inch. The air must be expelled from the apparatus at the beginning of the process. If impracticable to obtain the designated pressure, a longer exposure will accomplish the same result.

(*c*) Steam under pressure with vacuum. Steam in a special apparatus with vacuum attachment is the best method of applying steam under pressure, the object of the vacuum apparatus being to expel the air and to promote the penetration of the steam. The process is to be continued for twenty minutes after the pressure reaches 10 pounds to the square inch.

GASEOUS DISINFECTANTS.

154. Sulphur dioxide. Sulphur dioxide is efficient, but requires the presence of moisture. It is only a surface disinfectant, and is lacking in penetrating properties. An atmosphere containing 4.5 per cent can be obtained by burning 5 pounds of sulphur per 1,000 cubic feet of space. This amount would require the evaporation or

volatilization of about 1 pint of water. Under these conditions the time of exposure should be not less than twenty-four hours for bacterial infections. A shorter time will suffice for fumigation necessary to kill mosquitoes and other vermin.

155. The sulphur may be burned in shallow iron ovens (Dutch ovens) containing not more than 30 pounds of sulphur for each pot, and the pots should stand in vessels of water. Quicker and better results can be obtained from burning the same total amount of sulphur in a number of small shallow ovens (Dutch ovens), 5 to 10 pounds in each, than in a few large ovens. The sulphur ovens should be elevated from the bottom of the compartment to be disinfected in order to obtain the maximum possible percentage of combustion of sulphur. The sulphur should be in a state of fine division, and ignition is best accomplished by alcohol; special care to be taken with this method to prevent damage to cargo of vessel by fire; or the sulphur may be burned in a special furnace, the sulphur dioxide being distributed by a power fan. This method is peculiarly applicable to cargo vessels.

156. Liquefied sulphur dioxide may be used for disinfection in place of sulphur dioxide generated as above, it being borne in mind that this process will require 2 pounds of the liquefied gas for each pound of sulphur as indicated in the above paragraphs.

157. Sulphur dioxide is especially applicable to the holds of vessels, or to freight cars and apartments that may be tightly closed and which do not contain objects injured by the gas. Sulphur dioxide bleaches fabrics or materials dyed with vegetable or aniline dyes. It destroys linen or cotton goods by rotting the fiber through the agency of the acids formed. It injures most metals. It is promptly destructive to all forms of animal life. This property renders it a valuable agent for the extermination of rats, insects, and other vermin.

FORMALDEHYDE GAS.

158. Formaldehyde gas is effective if applied by one of the methods given below. Formaldehyde gas has the advantage as a disinfectant that it does not injure fabrics or most colors. It is not poisonous to the higher forms of animal life. It fails to kill vermin, such as rats, mice, roaches, bedbugs, etc. The method is not applicable to the holds of large vessels. Formaldehyde is applicable to the disinfection of rooms, clothing, and fabrics, but should not be depended upon for bedding, upholstered furniture, and the like, when deep penetration is required.[a]

159. Many formaldehyde solutions do not contain 40 per cent of formaldehyde, and all are apt to deteriorate with time. It is there-

[a] It should be noted that formaldehyde disinfection is more efficient in warm, moist, or still weather than in cold, dry, or windy weather.

fore necessary to use a quantity in excess of the amount prescribed in these regulations, unless the solution has been recently analyzed.

160. The following methods of evolving the gas may be used:

(*a*) Autoclave under pressure, three to twelve hours' exposure.

(*b*) Lamp generator, six to eighteen hours' exposure.

(*c*) Spraying, twelve to twenty-four hours' exposure.

(*d*) Formaldehyde and dry heat in partial vacuum, one hour's exposure.

(*e*) Chemical, as formalin-permanganate method of Russel, (see par. 166); formalin-aluminum sulphate-lime of Walker, (see par. 166).

161. The minimum number of hours' exposure as given above applies to empty rooms of tight construction containing smooth, hard, surfaces; the maximum number of hours' exposure applying in all cases to textiles and other articles of a similar kind requiring more or less penetration.

162. Autoclave under pressure. This method has considerable penetrating power when applied as detailed below. Rooms or apartments need no special preparation beyond the ordinary closing of doors and windows. Pasting, caulking, or chinking of ordinary cracks and crevices is not necessary. The doors of lockers and closets and the drawers of bureaus should be opened. In this apparatus use formalin (40 per cent), with the addition of a neutral salt, such as calcium chloride (20 per cent). The gas must be evolved under a pressure not less than 45 pounds. After the gas is separated from its watery solution the pressure may be allowed to fall and steam projected into the compartment to supply the necessary moisture. Use not less than 10 ounces of formalin per 1,000 cubic feet, and keep the room closed for three to twelve hours after the completion of the process. For large rooms the gas must be introduced at several points as far apart as possible. It is applicable to the disinfection of clothing and fabrics suspended loosely in such a manner that every article is freely accessible to the gas from all directions.

163. Lamp or generator. This method requires an apparatus producing formaldehyde by a partial oxidation of wood alcohol, and in using it the room or apartment should be rendered tight as practicable. Oxidize 24 ounces of wood alcohol per 1,000 cubic feet, and keep the room closed for six to eighteen hours, in accordance with the provisions of paragraph 160. This method leaves little or no odor. When applied to clothing and textiles, the articles should be suspended in a tight room and so disposed as to permit free access of the gas. (See also par. 161.) The wood alcohol should be of 95 per cent strength, and should not contain more than 5 per cent of acetone.

164. Spraying. The formalin (40 per cent) should be sprayed on sheets suspended in the room in such a manner that the solution

remains in small drops on the sheet. Spray not less than 10 ounces of formalin (40 per cent) for each 1,000 cubic feet. Used in this way a sheet will hold about 5 ounces without dripping or the drops running together. The room must be very tightly sealed in disinfecting with this process, and kept closed not less than twelve hours. The method is limited to rooms or apartments not exceeding 2,000 cubic feet. The formalin may also be sprayed upon the walls, floors, and objects in the rooms.

This method is markedly interfered with and is not to be relied on at low temperatures, say, below 72° F. At 43.5° F. very little formaldehyde is liberated, the formaldehyde being polymerized on the sheets.

165. Formaldehyde with dry heat in partial vacuum. This method has superior penetrating powers and is specially applicable to clothing and baggage. The requirements of this method are (1) dry heat of 60° C. sustained for one hour; (2) a vacuum of 15 inches; (3) formaldehyde evolved from a mixture of formalin with a neutral salt, in an autoclave under pressure, using not less than 30 ounces of formalin (40 per cent) for 1,000 cubic feet; and (4) a total exposure, under these combined conditions, of one hour.

166. Chemical, as—

(1) Formalin permanganate method. When formalin is poured over crystals of permanganate of potash, a vigorous reaction takes place, and a large quantity of formaldehyde gas is liberated. Reaction is over in a short time, five minutes, and if a proper proportion of substances is used, the residue is almost dry. The proportion is 2 pints of formalin to 1 pound of permanganate of potash. One pint of formalin for 1,000 cubic feet of space, should be used if the temperature is 60° F. or less, a less amount may be used for higher temperatures, but not less than 10 ounces per 1,000 cubic feet. This method is extremely efficient on account of the rapidity with which the gas is liberated, but the danger of fire should be guarded against, as the formaldehyde gas, being in a comparatively dry state, is inflammable in the presence of a light, such as lighted matches, lamp, etc.

(2) Formalin-aluminum sulphate-lime method. Add 1 part sulphate of aluminum to 2 parts of hot water. One part of this solution is added to 2 parts of formalin (both by volume). One part of this second solution is poured on 2 parts of unslacked lime (quick lime), broken into small particles. The process of liberation of formaldehyde gas is completed in about twenty minutes. This method is not as efficient as the previous one, as less than half the amount of formaldehyde gas is yielded from the same amount of formalin.

Two pints of formalin per 1,000 cubic feet of space should be used, if the temperature is 60° F. or less.

Fire should be guarded against, but this danger is decidedly less than in the permanganate process on account of the large amount of water vapor coming off with the gas.

167. The stated times of exposure to sulphur dioxide and formaldehyde are sufficient to destroy bacterial infection due to non-spore-bearing organisms, providing that the infection is present on the surface. If the room is of peculiar construction, so as to impede the diffusion of the gas, or if the room is a dirty one, or if on account of any other condition rendering the germicidal action of the gas more difficult, the time of exposure should be proportionately increased, or supplanted by other methods.

CHEMICAL SOLUTIONS.

168. Bichloride of mercury. Bichloride of mercury is a disinfectant of undoubted potency and wide range of applicability. It can not be depended upon to penetrate substances in the presence of albuminous matter. It should be used in solutions of 1 to 1,000. The solubility of bichloride of mercury may be increased by using sea water for the solution, or by adding 2 parts per 1,000 of sodium or ammonium chloride to the water employed.

169. Carbolic acid. Carbolic acid in the strength of 5 per cent (see par. 52) may be substituted for the bichloride of mercury, and should be employed in the disinfection of the cabins and living apartments of ships to obviate injurious action on polished metals, bright work, etc.

170. Formalin. Formalin containing 40 per cent of formaldehyde may be used in a 5 per cent solution as a substitute for bichloride of mercury or carbolic acid, and is useful for the disinfection of surfaces, dejecta, fabrics, and a great variety of objects, owing to its noninjurious character.

APPLICATION OF DISINFECTANTS IN QUARANTINE WORK.

171. Hold of iron vessels, empty, shall be disinfected by either:

(*a*) Sulphur dioxide generated by burning sulphur 5 pounds per 1,000 cubic feet of air space, or liberated from 10 pounds of liquid sulphur dioxide, sufficient moisture being present in both cases; time of exposure, twenty-four hours. (See par. 154.)

(*b*) Washing with a solution of bichloride of mercury, 1:1,000.

172. Holds of wooden vessels, empty, shall be disinfected by—

(*a*) Sulphur dioxide in the manner prescribed above, followed by

(*b*) Washing with a solution of bichloride of mercury.

173. Holds of cargo vessels, when cargo can not be removed, shall be disinfected in so far as possible by sulphur dioxide not less than 4 per cent per volume strength, and where possible this should be generated from a furnace to minimize danger of fire in cargo.

174. Living apartments, cabins, and forecastles of vessels shall be disinfected by one or more of the following methods:

(*a*) Sulphur dioxide, the destructive action of the gas on property being borne in mind.

(*b*) Formaldehyde gas.

(*c*) Washing with solution of bichloride of mercury, 1:1,000, or 5 per cent solution of formalin, or 5 per cent solution of carbolic acid, preference being given to carbolic acid for application to polished woods, bright metals, and other objects injured by metallic salts.

The forecastle, steerage, and other living apartments in bad sanitary condition must be disinfected by method (*a*) followed by method (*c*).

175. Mattresses, pillows, and heavy fabrics are to be disinfected by—

(*a*) Boiling.

(*b*) Flowing steam, i. e., steam not under pressure.

(*c*) Steam under pressure.

(*d*) Steam in a special apparatus with vacuum attachment.

176. Clothing, fabrics, textiles, curtains, hangings, etc., may be treated by either of the above methods from (*a*) to (*d*) inclusive, as circumstances may demand, or by formaldehyde gas or sulphur dioxide where the article is of a character which will not be damaged by sulphur dioxide.

177. Articles injured by steam, such as leather, furs, skins, rubber, trunks, valises, hats and caps, bound books, silks, and fine woolens should not be disinfected by steam. Such articles should be disinfected by formaldehyde gas or by any of the agents allowed in these regulations which may be applicable thereto. Those which will be injured by wetting should be disinfected by a gaseous agent.

178. Clothing, textiles, and baggage, clean and in good condition, but suspected of infection, can be efficiently and least injuriously disinfected by formaldehyde gas, generated by one of the methods prescribed in paragraph 160—(*a*), (*b*), or (*d*).

179. Textiles which are soiled with the discharges of the sick or presumably are deeply infected must be disinfected by—

(*a*) Boiling.

(*b*) Steam.

(*c*) Immersion in one of the germicidal solutions.

180. Cooking and eating utensils are always to be disinfected by immersion in boiling water or by steam.

AGENTS FOR THE DESTRUCTION OF MOSQUITOES, RATS, AND OTHER VERMIN, AND THEIR APPLICATION TO QUARANTINE WORK.

181. Sulphur dioxide—obtained as described in paragraphs 154 and 155—destroys all animal life.

182. In the case of vessels, when treated for yellow fever infection, the process shall be a simultaneous fumigation with sulphur dioxide,

2 per cent volume gas, and two hours exposure, in order to insure the destruction of mosquitoes.

183. In the case of vessels when treated for plague the process with sulphur dioxide shall be as follows:

Without cargo: The simultaneous fumigation with sulphur dioxide gas not less than 2 per cent for six hours' exposure.

With cargo: Fumigation with sulphur dioxide gas, 4 per cent, six to twelve hours' exposure, according to stowing.

Infected vessels may require partial or complete discharge of cargo, and fractional fumigation for efficient deratization.

184. Pyrethrum. The fumes of burning pyrethrum may be used to destroy mosquitoes in places where there are articles liable to be injured by the use of sulphur.

Four pounds per 1,000 cubic feet space for two hours' exposure with this amount all or practically all of the mosquitoes will be killed, but precautions should be taken to sweep up and destroy any that may have escaped.

Pyrethrum stains walls, paper, etc.

185. The oxides of carbon, as used at Hamburg, are efficient to destroy rats but do not kill fleas or other insects. They are obtained by burning carbon, coke, or charcoal, in special apparatus, and the gas as produced consists of about 5 per cent carbon monoxide, 18 per cent carbon dioxide, and 77 per cent nitrogen.

Twenty kilos of carbon, coke, or charcoal are used for every 1,000 meters of space. The gas is allowed to remain in the ship for two hours and from seven to eight hours are allowed for it to leave it. This is about equivalent to $1\frac{1}{3}$ pounds of carbon (coke) to 1,000 cubic feet of air space. As this gas is very fatal to man and gives no warning of its presence, being odorless, a small amount of sulphur dioxide should be added to give warning of its presence. As it does not kill fleas it can not be depended on for complete work, where there is evidence of plague among rats on the vessel, as the infected fleas would infect the rats coming aboard after the deratization.

186. The articles named as disinfectants which can obviously destroy animal life can be used for that purpose when applicable, as steam for bedding, fabrics, etc. Formaldehyde is not applicable for this purpose.

187. Where both disinfection and destruction of vermin are required for mattresses, pillows and fabrics, the use of steam meets both requirements, and is especially applicable.

188. Hydrocyanic acid gas is fatal to all forms of animal life and is not injurious to any material. It is best generated by mixing—

Cyanide of potash	4
Sulphuric acid	6
Water	9

The acid should first be diluted, which must be done in some vessel capable of withstanding the heat. The whole amount of the cyanide of potash must be put in the acid at once, and as the evolution of the gas is very rapid, the operator must be prepared to leave immediately. Fulton advises that the cyanide be tied in a bag, to be lowered into the acid by a cord passing outside of the room.

About 10 ounces of cyanide of potash per 1,000 cubic feet.

It is of course applicable when necessary to destroy mosquitoes or vermin (particularly in living quarters), but is too dangerous to be used except by those experienced in its use.

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THE RELATION OF CLIMATE TO THE TREATMENT OF PULMONARY TUBERCULOSIS

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THE RELATION OF CLIMATE TO THE TREATMENT OF PULMONARY TUBERCULOSIS.

By Surgeon F. C. Smith.

Tuberculous patients are sometimes puzzled by conflicting medical advice on the subject of climate in its relations to the treatment of their disease. It is not surprising that diverse opinions prevail. From very early times the cure of tuberculosis has been associated, more or less, with certain places, and, as Klebs says: "At one time or another almost any combination of known atmospheric conditions was considered to constitute a climate which had protective or curative qualities for consumptives." The reason for this is found, of course, in the fact that pulmonary tuberculosis is a chronic disease, depending for arrest upon a large number of factors, many of which are independent of atmospheric conditions and common to all climates.

Another thing which has added to the confusion of ideas on the subject has been the search for "immune zones," regions where tuberculosis is rare or absent, the inference being that such places offer climatic conditions useful in treating the disease. No region, however, has long continued free from tuberculosis after being reached by modern civilization. Remote districts became infected rapidly as soon as the disease was introduced. Thinly populated areas, whatever their geographical position, become tuberculosized wherever cities are built and confining trades established. Latham states that tuberculosis is rife among the watchmakers of the high Alps. The death rate from tuberculosis among our native Indians is not appreciably less in those tribes which have always lived in the arid Southwest and other favorable climates. Neither the salts in sea air, the ozone of forests, nor the rarefied atmosphere of mountains are remedial in themselves; they simply typify an outdoor life. Physicians are practically agreed that there is no specific climate for tuberculosis.

But, beyond all question, an open-air life is more pleasant in some climates than in others, and an open-air life in varying degrees of rest and activity is one of several important elements in the

proper treatment of tuberculosis. The gain in comfort and thoroughness with which an outdoor existence can be followed in selected climates and the relation of certain complications to special atmospheric conditions must be considered against a possible loss in the facilities with which other essential therapeutic measures will be carried out.

The following expressions are representative of recent medical opinion.

Baldwin, Saranac Lake:

Change of climate is often of great value, but is not a necessary thing in all cases. It is largely dependent upon the means of the patient and also upon the environment at home. A change to a higher altitude and a more invigorating atmosphere is nearly always advantageous where the means are sufficient and proper supervision can be obtained. Experience shows that a minimum of $10 a week is required for the expenses of patients in most of the health resorts, unless they can enter a semicharitable sanatorium. Hence it is inadvisable for patients who are unable to command the above sum to leave home.

Hillier, of London:

Climates of every variety have at one time and another been recommended for consumption. High altitudes and the seaboard, warm climates and cold ones, the ocean and the desert, the equator and the poles. The underlying truth is at last being recognized. The chief virtue of these resorts is the open-air life.

Flick, Philadelphia:

Expert medical advice is the most important factor in effecting a cure, and doctors at home are now as well up on the disease as doctors at climatic resorts, though formerly this was not so. A long period of treatment is required, no matter where undertaken, and proper treatment at a distant resort is prohibitive for the poor, and often embarrassing for the well to do. I desire to go on record as believing that there is no therapeutic value in climate.

Anders, of Philadelphia (Practice of Medicine, 1911):

Experience and observation have shown that certain climates, selected with particular reference not only to the stage of the affection, but more particularly to the individual, are useful modifying influences of the tissue soil. In any case of tuberculosis that climate is most suitable in which the patient "feels well, eats well, sleeps well, and gains flesh and strength." (Delafield.)

Latham, of London (Diagnosis and Modern Treatment of Pulmonary Consumption):

The results of sanatorium treatment in a variety of climates have shown that the old ideas of a particular climate or altitude being a specific for pulmonary consumption are erroneous, and have proved that climate is only one, though an important, factor in the treatment. Most physicians who have had much experience of sanatorium treatment, and who have watched patients for some years after their return from a sanatorium, agree that as far as possible *all patients should be treated under the same climatic conditions as those which they are likely to experience in their subsequent life.* (Italics are Latham's.)

Minor, of Asheville, N. C., in an article for popular use:

If you have money enough to go away to a favorable climate and get there good board, care, and accommodations, it will be a great help to you; but *change of climate is not the first or most important thing,* and, unless you have money enough to get in the climatic resort as good or better conditions than you have at home, you had much better stay at home and spend what money you have in getting the best possible conditions you can there. (Italics are Minor's.)

Walsh, of Philadelphia:

If a case of consumption can not be cured in its home climate, it can not be cured anywhere.

Osler (Practice of Medicine, 1907):

(c) *Climatic treatment.*—This, after all, is only a modification of the open-air method. The first question to be decided is whether the patient is fit to be sent from home. In many instances it is a positive hardship. A patient with well-marked cavities, hectic fever, night sweats, and emaciation is much better at home. and the physician should not be too much influenced by the importunities of the sick man or his friends.

* * * * * * *

Very much is said concerning the choice of locality in the different stages of pulmonary tuberculosis, but when the disease is limited to an apex, in a man of fairly good personal and family history, the chances are that he may fight a winning battle if he lives out of doors in any climate, whether high, dry, and cold or low, moist, and warm.

Dunham, 1904, after visiting discharged Massachusetts Sanatorium patients in the West, and upon comparing Massachusetts Sanatorium statistics with those of the United States Army Sanatorium at Fort Bayard, New Mex.:

The results corroborate our belief in the efficacy of residence in dry climates, but with a smaller margin in its favor than was anticipated. * * *

The proportion of people adapted for treatment in these extremes of climate must be more nearly equal than thought possible by climatologists generally. That is to say, a small majority of the patients at Rutland would probably do better at Fort Bayard and a large minority there might do better here.

Francine, of Philadelphia (Pulmonary Tuberculosis, 1907):

At first and for a considerable time mountainous regions or high altitudes were considered essential sites for sanatoria, as the potency of climate per se was exaggerated or at least not rightly understood. Nor can this question be considered settled even to-day, though it seems probable that the importance of the other factors in sanatorium treatment, i. e., rest, fresh air, diet, and regular regimen, are receiving juster appreciation than heretofore. The feeling seems to be gaining ground in the profession that it is not so much a particular climate which accomplishes results as it is fresh air, and plenty of it, in association with the other factors in modern treatment. * * * The view is held by some with wide experience to substantiate their claims that change of climate is unnecessary and even unadvisable and that quite as good results may be obtained by treating the patient in his own home; these latter enthusiasts have swung completely over, and disregard climate while emphasizing the importance of care and treatment. It seems probable that the just view lies somewhere midway between these two extremes.

Bonney, of Denver (1910):

The prevailing tendency to provide home sanatoria for all classes and repudiate established facts of climatic influence is to be deplored. Climate is a valuable adjuvant to other measures of therapeutic management, but the same watchful observation by an expert physician is necessary for good results. Choice of a climate is a delicate and important matter. In all cases climatic selection becomes for the patient a question of individual fitness. The last 313 cases coming under my personal observation in Denver included 90 of doubtful diagnosis and 125 others unsuitable for the change of climate on account of the complications, or advanced and rapidly progressing disease.

Pottenger, of Monrovia, Cal.:

Given the same treatment, climate is valuable. Patients of small means should remain at home under intelligent guidance instead of stinting themselves in a better climate. Favorable climate is not essential, but it makes the cure easier, and at the same time favors it.

Bowditch, V. Y., of Boston:

* * * Equally foolish to say that it is no longer necessary to send patients to a distant clime or that every patient must go far away to regain health.

Knight, of Boston (deceased):

Undoubtedly there is something in climate influences. Am sure there can be no contention as to the advantages of certain forms of climatic treatment in connection with other methods of personal hygiene.

Knopf, of New York:

The value of certain climatic regions in the treatment of pulmonary tuberculosis, particularly of high and dry climatic resorts, must be acknowledged. A change of climate is nearly always good, except in the very latter stages of the disease, when it should only be made in case of a well-to-do patient and upon his expressed desire. Even a change from a good to a seemingly less favorable climate may accomplish a certain amount of good. The danger of relapse is greater to those returning from distant resorts after a short sojourn, before they have become thoroughly acclimated or their disease cured or arrested. Suitable and beneficial differences are not infrequently found in climates very near home. Thus, for example, a removal from New York slums to North Brother Island, within the city limits, constitutes a climatic change beneficent to the majority of indigent cases.

In the selection of climate for a tuberculous patient, his likes or dislikes for warm or cold weather, or his possible idiosyncrasies for high or low altitudes, and the presence of chronic dry or moist nasal catarrhs must be taken in consideration, those with dry catarrhs usually doing better in relatively moist regions and vice versa. The majority of tuberculous patients (particularly those coming from the laboring classes) should, if at all possible, be treated in climates where they will have to live and labor after their restoration to health.

THE IMPORTANCE OF CLIMATE COMPARED WITH THAT OF OTHER THERAPEUTIC MEASURES.

The most important factors in promoting recovery from pulmonary tuberculosis are:

1. *Adequate and intelligent rest.*
2. *Proper and sufficient food.*
3. *Abundance of pure air.*

These, under the direction of skilled medical service, constitute a well-ordered hygiene. It would be difficult to name the relative values of these factors. No one of them is essential in all cases, for recoveries occur under very unhygienic conditions. Various pathologists estimate that 50 per cent, or even more, of infected people recover without knowing that they have had a serious disease. But for those who come to a doctor and in whom the disease is discovered, such spontaneous recoveries must be ignored, and rest, food, and air prescribed according to the patient's financial condition.

Obviously all are not equally able to afford these things. Comparatively few of those suffering from tuberculosis can realize ideal conditions for recovery. A limited purse can procure rest for a limited time, or in inadequate degree, and fresh air is often expensive just as is choice food. Fresh air is expensive in the city, because it means proper housing in a good location. How much that costs in a city like New York, for instance, is readily understood. Removal from the city entails an initial expense, with perhaps, business sacrifices for the earning member of the family. Additional clothing required to protect the body from cold adds to the expense of fresh air. Just as the circumstances of a patient may prevent him from securing the best house or the best food, so he may not be able to get the best fresh air—i. e., the best climate. If we grant that there are differences in climates, just as there are differences in houses, still, excellence of climate is no more essential to a cure than excellence of some other things, and there is no climate so good that it will always make up for increased work or poorer housing, or scantier fare, if necessitated by a change.

Each case should be decided on its own merits, and where sacrifices must be made they should be duly apportioned, in regard to both the immediate and also the remote aspects of the case. For one with fever, sweats, and rapid wasting, absolute rest in bed, with good ventilation and good nursing, is an immediate necessity, outweighing other considerations. On the other hand, unfavorable climatic conditions, such as oppressive heat, irritating dust or smoke, extreme cold, or an atmosphere of melting snow and constant fog may exercise such a bad effect on a case fit to travel that a suitable change of climate

becomes an urgent necessity and should be undertaken, even at considerable sacrifice.

The wealthy, who are able to surround themselves with comforts and can command expert service wherever they go, may seek a change whenever it is indicated, weighing only the ill effects of a journey against the natural advantages of the place selected. Besides the wealthy, there is a class following occupations which allow a transfer from one region to another with little sacrifice of means. Railroad employees in certain capacities, telegraph operators, etc., and Government employees in some departments, are often able, by the courtesy of their superiors, to effect a transfer of their duties to a climate more favorable to themselves or to a tuberculous member of their family. The three principal medical services of the Federal Government have selected for their respective sanatoria locations in the arid Southwest, in what was adjudged the most suitable climate for young, adult males. But in locating State and municipal sanatoria the governing boards have in each instance chosen a site within their own domain; economic considerations, accessibility, and opportunities for administrative control outweighing any increased therapeutic value a distant climate might have afforded. The majority of patients will be in the same relation to their families that the public sanatorium bears to its State and the same economic principles will usually apply to the disposition of the case.

PRELIMINARY OBSERVATION AND STUDY OF CASE BEFORE ADVISING CHANGE OF CLIMATE.

As a routine procedure, the practice of advising a change of climate to a distance is unwarranted. The consensus of opinion is that certain changes are desirable in certain cases, but precipitate haste in ordering a patient away is a mistake. Sometimes a change is either unnecessary or useless, and moreover, a climate adapted to the needs of one individual may be wholly unsuited to those of another.

The doctor who habitually prescribes a distant removal is usually one who still harbors the idea that there is a specific climate for tuberculosis. Such a physician is an exponent of some particular region, from fashion or caprice or from lack of knowledge of other places. The old adage "Consumption, therefore, creosote or Colorado" is equally expressive of therapeutic and climatic ignorance. The reproach so frequently heard from resort specialists that patients are not sent early enough, that the family doctor holds them too long, has probably done more harm than good. The case that should be sent to a distant climate immediately upon diagnosis is exceptional, nor should neglect to make an early diagnosis stand sponsor for precipitate haste in sending the victim away when it is finally estab-

lished. At the Marine-Hospital Sanatorium, Fort Stanton, N. Mex., the results have been nearly three times as good in the cases which left the home stations—i. e., the local marine hospitals—without fever as in those who had a temperature of 38° C. or more within two weeks of departure. The deaths in those leaving afebrile were to those leaving with fever, as 22 to 59, the arrests as 19 to 7½, the apparent cures as 10 to 3. A period of observation is frequently desirable in order to exclude hopeless cases and to permit an intelligent selection of climate if a change is needed, the character of each case offering its individual indications.

But there should be no delay in instituting the regimen upon which a cure will depend, no matter where undertaken, whether a removal is contemplated and whether the time set for departure is near or remote.

HOPELESS CASES NOT TO BE SENT TO A DISTANCE.

It is not always easy to determine when a case of pulmonary tuberculosis is hopeless, but in general the far advanced case that does not offer some hope of temporary arrest in the home climate, when treated in a local sanatorium, or under other favorable conditions, can not be expected to improve under the same conditions after a long journey, no matter what the difference in climate. A progressing case of long standing, with abdominal organs already damaged by terminal changes of the disease, and dependent on nursing for comfort, is in no condition to be benefited by a change of climate. Occasionally a critical case recovers or life is prolonged beyond all expectation in a health resort, but the same thing occurs in similar cases in home climates. In the elevated western regions, so frequently selected, a patient grows worse faster or improves faster, as the case may be, than in less stimulating climates. At the Marine-Hospital Sanatorium, Fort Stanton, N. Mex., there were 130 deaths within one month of arrival, and 308 in from one to six months after arrival, out of a total of 861 deaths. It makes little difference to a dying man what the climatic conditions are so long as he has proper care. A few hours of extra sunshine per day or a decreased amount of precipitation have not the same value to a moribund case that they have to one less ill. Unfortunately, the evil results of exiling the hopeless cases are not so apparent to those responsible for it as to those among whom the unhappy sufferers go, for there is no picture more miserable than the boarding-house life of a consumptive, hopelessly ill among strangers. Surveys made by the Public Health Service show that, while owing to educational propaganda, hopeless cases are less often sent away, migration of the tuberculous is not decreasing. Large numbers of the indigent tuberculous become charges on various charitable agencies, especially in the Southwest.

THE PSYCHOLOGICAL MOMENT FOR CHANGE.

Almost any case of tuberculosis which may be expected to result favorably, as well as many hopeless cases, will, when kept in bed in freely flowing air anywhere, improve for a time and up to a certain point.

As a rule, indeed, routinely, it is best to carry the patient as far along the road to health as seems possible (within certain limits) by treatment at home, at least to relieve all symptoms so far as may be, before contemplating a change. After comparative quiescence of the lung process has been reached under treatment at home, and the nutrition is much improved, there comes a stage where further improvement is slow. This is the psychological moment for change. In speaking of change I mean a complete change to health resorts in the far West: or those in the East at considerable distance from the patient's home. (Francine.)

It can not be too frequently repeated that each case must be decided individually. A delicate, anemic woman who feels the cold keenly and can not be trained to face veranda life in the damp rigors of a New England winter, is so much benefited by a sojourn of three months in some southern winter resort where outdoor life can be comfortably followed that the advantages of the temporary change outweigh the pangs of homesickness. One with flagging digestion and relaxed nervous and vascular system, sweltering in the heat of a southern July, may find a removal to the sparkling air of some elevated western region or to the invigorating atmosphere of a cool beach resort a life-saving measure.

GENERAL ASPECT OF THE INVASION.

The amount of lung tissue involved is by no means the only thing to be considered. Frequently the finding of tubercle bacilli in the sputum of a man coming to his physician with no serious symptoms causes the case to be referred to a specialist in diseases of the chest who elicits the history of an unrecognized attack of tuberculosis occurring several years previously, and finds, clinically, an arrested process. The pathological condition may correspond to that of a case just returned from a successful period of climatic treatment. Obviously, such a newly diagnosed case is not subject to the same rules as certain others. Again, the presence of a small area of active disease in one part of a lung, showing arrest in other parts, may put the case in the same class as an incipient attack. Or the presence of terminal changes, fatty kidney, amyloid liver, etc., from long standing tuberculosis may put a case with even a slight degree of activity in the class with those hopelessly ill. Moreover, certain types are florid from their onset, the so-called pneumonic cases, as well as the miliary variety, and it is certain that the influence of climate is practically negligible in such acutely progressing disease.

For certain complications, skillful treatment by an appropriate specialist is so important that all other considerations may be disregarded for the time and the most skillful service sought, regardless of climate. In general it may be said that any complication which confines the patient to bed is best met where the best nursing facilities are to be found.[1]

THE LOCAL SANATORIUM.

A preliminary observation for a few months in a local sanatorium is invaluable in determining the character of a recently diagnosed tuberculosis. The number of these institutions is increasing almost daily, and within a few miles of any large city will be found charitable, semicharitable, and private fresh-air hospitals for any class of cases. Here an idea of the resistance of the individual and the indications to be met can be obtained. The habits of life which that consumptive must observe who will either live with or cure his disease in any climate are best learned in such an institution where the inmates are devoted to the business of getting well. There is, in a well-ordered sanatorium, an esprit de corps among the patients themselves, an intelligent, buoyant, helpful cooperation not altogether unlike college spirit, and the special training afforded in a vital matter in such a place may well liken the sanatorium to a school, as, indeed, it is. North Carolina has recently changed the name of her State sanatorium to the State Training School for Tuberculosis.

The position of a specialist in diseases of the lungs is analogous to that of a surgeon, and for the best results the former should often be consulted just as, in another class of diseases, the latter would be. A surgeon competent for ordinary emergencies can be found in any, even the smaller, cities; but while special training in pulmonary tuberculosis is rapidly developing and in a few years will be easily available in any part of the country, it has now often to be sought for in special places, and the sanatorium is one of these.

THE GENERAL PRACTITIONER'S POINT OF VIEW.

The family doctor, having made a skillful diagnosis, absolute or provisional, is immediately confronted with the question, What are the best opportunities for recovery which this patient's means will allow? For, as Edson says, "the best he can get is what we must order, both as regards food, bedroom, and quality of air." If the case is in a family of wealth, his task is simplified, as he has merely to decide whether a change of climate is necessary or justifiable and the

[1] For several years past the Bureau, United States Public Health Service, has transferred to its New Mexico sanatorium only patients whose temperature and pulse could be brought to normal by rest in bed at the local hospital.

nature of the change indicated, and he may give his advice accordingly, knowing that adequate means will everywhere command skilled service, home comforts, solace, and diversion. In the vast majority of cases, however, he must weigh the benefits of a change against certain sacrifices usually necessary to effect it, and here must be considered a multitude of details, some of which the family doctor is in a position to decide upon better than anyone else and some of which, without special training in tuberculosis, he will make a mistake in attempting to decide. Even when treatment in the home climate has been decided upon, there are some who insist that their patient enter a local sanatorium for several months for the preliminary training necessary to a successful regimen at home.

If the case has a favorable outlook and a good chance to recover in the home climate, the fact often remains that there would be a still better chance in some other climates. He desires to prescribe nothing short of the very best conditions. He recalls, too, that a "change of climate" is time-honored advice, the patient expects it perhaps, and there will be less responsibility for an unfavorable outcome if he gives it. He may measure the vexations of home treatment against inadequate fees, and remember that he has even been accused of mercenary motives in holding certain favorable cases for home treatment. It must be confessed that it requires considerable courage for a physician to recommend "no change," and it can be said without equivocation that the family doctor who undertakes to treat a case of pulmonary tuberculosis in a home of any kind is guided by duty and altruism and not by the financial aspects of the case. The layman, always following medical teaching of a decade previous, is more ready to do "some great thing" than to bathe seven days and nights in the week in the outdoor air of home. Indications for or against a removal are found in the home itself. A nervous man or woman may need to be taken from a turbulent household of lusty children, while for a differently constituted case congenial relatives are indispensable for content. Extreme measures are sometimes necessary to get a careless patient away from helpless associates, or, on the other hand, to save an invalid from false ideas of treatment at the hands of ignorant relatives.

Moreover, a multitude of counsel confuses the busy practitioner. The resort specialists, each perhaps convinced of the excellence of a particular climate by a self-cure there, urge the merits of various regions. They insist that the case be sent without delay, fix two or five years as the probable duration of treatment, and perhaps raise a question at the same time against the propriety of an ultimate return to home climatic conditions. Moreover, he has been convinced that hygiene and good medical attendance are as necessary in the new

climate as the old, and that the claims of a sanatorium are as strong in a distant health resort as they are in the home city.

He can recall some sad experiences of previous days when his early cases went West to "rough it," or of later ones where patients thought that they could loiter in smoky lobbies and attend the evening dances and effect a cure simply because they were breathing the pure air, or the rarified air, or the dry air of some widely advertised "climate."

But it is often easier to persuade a patient to enter a sanatorium at a distant resort than a similar one near home, and sometimes an adult male can be persuaded to abandon his business persuits only by radical removal from the scene of his activities. Especially is this true of physicians. The stimulation of hope afforded by a complete change is frequently needed where a patient has met repeated reverses in his own case or has seen unfavorable outcomes in a number of friends or relatives. With all this the family doctor must study the tastes and habits of his patient. The indications for change are different for a home-loving, carefully nurtured girl than for her bachelor brother. Young adults often welcome a change, whereas one past middle life, with strong attachment for home scenes, may consider it a hardship. For the very young or the very old a removal simply for change of scene would almost never be indicated.

Temperament and previous climatic environment are important. One would not, for instance, send a Norwegian youth to the Azores nor a Creole demoiselle to winter in the Adirondacks. A thin, irritable person, who shrinks at sudden drops in temperature, would not be advised to go to Colorado, nor would a full-blooded, lusty individual ordinarily be directed to a warm beach resort.

In deciding whether a case of pulmonary tuberculosis should have a change of climate, temporary or permanent, remote or near, the doctor must not be bound by any rule, but be guided in each case by all the attending circumstances—by the patient's age, sex, and social condition, wealth, temperament, and desires, by the stage and activity of the disease and its complications. He will be influenced by the home climate and the season of the year, but it is safe to say that no place is so unfavorably situated that a general recommendation for change can be made, and none so fortunate in its location as to preclude the possible advisability of a removal.

HOME CLIMATES.

Local weather conditions at certain seasons may strongly indicate a temporary removal from some localitie When crowds of well people press out of a hot city to the nearest cool resort the doctor may well cast about for similar relief for his consumptives. The most frequently indicated change is one to avoid excessive heat, for it is

now realized that, making allowances for idiosyncracy, cold air is especially stimulating to metabolism and, therefore, peculiarly suitable to the treatment of pulmonary tuberculosis. The tonic effects of cold air with increased appetite and power of assimilation account for much of the good results ascribed to the dryness and elevation of Colorado. Most city dwellers know of some near-by country resort where comfort is increased during the summer months, and, with the consumptive, as with others, comfort is the chief motive for a change. There are few parts of the United States so situated as not to have within comparatively short distances places with climatic conditions so different as to constitute a marked change, and as J. C. Wilson has said, "It is sometimes not so much the climate to which the patient goes as the climate from which he is taken." The change from a hot city to a cool country place may be as radical as a removal from a suburban mansion to New Mexico plateaus.

Within a few hours' ride of any large city can be found comfortable resorts. The mountains of the Virginias and Pennsylvania are especially rich in places where, with proper medical attendance, favorable climatic conditions for consumptives are found. The climate of the Adirondacks is only representative of the wooded country of that latitude. Almost every State on the Canadian border has forests at moderate elevations where, with only occasional extremes of temperature, a stimulating atmosphere lends comfort to an outdoor life.

The Central Plateau of Massachusetts embraces 700 square miles and bears a score of small cities, all at an altitude of 1,000 feet or more. In one of these, Rutland, a State sanatorium is located, and from this place, as well as from Petersham and Templeton, Mount Greylock in the Berkshires, 60 miles away, can be plainly seen as many as 60 days in the year. In view of the accessibility of this region and the excellent results obtained at the State institution, it is gratifying that numerous private sanatoria are being opened there.

Ulster, Greene, and Sullivan Counties around New York City are frequently mentioned as containing many desirable locations for consumptives. Judd, of Philadelphia, describes a plateau 1,800 to 2,000 feet high in Monroe County, Pa., conveniently near several of the largest eastern cities, and, as is well known, there are hundreds of cool beach resorts from Maine to far south on the Atlantic seaboard. Asheville, N. C., well known as a health resort, is illustrative of the stimulating climate of the mountainous regions of North Carolina, Tennessee, and Kentucky.

Moreover, it should be remembered that there is no ideal all-the-year-round climate for the average consumptive. Physicians of Denver sometimes send patients out of that city into neighboring mountains during certain months of the year to avoid unfavorable

weather conditions. Craig, of Phoenix, suggests that all-the-year health seekers in Arizona should spend summer in Flagstaff, fall in Prescott, and winter and spring in Phoenix. Climatic conditions vary greatly within short distances, not only in California and Colorado, but also in many Eastern States, where mountains are found near the ocean.

There are certain advantages in undertaking the cure in one's own home climate, and by this term is usually meant places not more distant, for instance, than the confines of the home State. The limitations of one's own climate are known and will not be presumed upon, whereas the faith inspired by a removal to some specially selected climate often weakens the regimen which is necessary anywhere. Moreover, a return to home climatic conditions is more apt to show a lapse from the careful hygiene which was followed with comfort in a favorable spot but seems a hardship in more rigorous climes. As Hillier says, "The man who has braved wind and weather in an English or German sanatorium will more readily stay out of doors and open his windows when he gets back to every-day life at home than one who has just returned from the Mediterranean or the cape."

The short-distance change is admirably adapted to the needs of the average individual for whom a removal from business cares or unfavorable home surroundings is indicated. It is probable that the advantages of near-by resorts have not been fully realized by busy, general practitioners, and the therapeutic value of such changes has been lost sight of in radical removal to a distant climate. But climatic therapeutics are not exact. Indeed, as Anderson, of Colorado Springs, has said, "The matter of climate is largely one of experiment." A short-distance change is obviously a less costly experiment than a long-distance change.

The following list, perhaps incomplete, showing location of various State sanatoria, is added, because, when intelligently selected, such sites are representative of the healthful regions of a State. The superintendent of such a public institution is also in a position to know the location of private sanatoria in his neighborhood, and is more or less in the habit of answering inquiries concerning the tuberculosis situation in his own State.

Arkansas.—Booneville.
Connecticut.—Hartford, Meriden, Norwich, and Shelton.
Delaware.—Marshallton.
Georgia.—Alto.
Indiana.—Rockville.
Iowa.—Oakdale.
Kansas.—Norton.
Maine.—Fairfield and Hebron.
Maryland.—State Sanatorium, Salisbury, and Towson.

Massachusetts.—Rutland, Middleboro, North Wilmington, Westfield, and Tewksbury.
Michigan.—Howell.
Minnesota.—State Sanatorium (Cass County).
Missouri.—Mount Vernon.
Montana.—Deer Lodge.
Nebraska.—Kearney.
New Hampshire.—Glencliff.
New Jersey.—Glen Gardner.
New York.—Ray Brook.
North Carolina.—Sanatorium.
North Dakota.—Dunseith.
Ohio.—Mount Vernon.
Oregon.—Salem.
Pennsylvania.—Mount Alto, Cresson, and Hamburg.
Rhode Island.—Wallum Lake.
South Carolina.—Columbia.
South Dakota.—Custer.
Texas.—Carlsbad.
Vermont.—Pittsford.
Virginia.—Catawba Sanatorium (Roanoke County.)
West Virginia.—Terra Alta.
Wisconsin.—Statesan (Waukesha County).

SPECIAL CLIMATES.

The practice of sending consumptives away to high altitudes is fraught with greater possibilities for good or for evil than any other change commonly made. Such places in the United States are dry, cool, and stimulating, with a large number of clear days and a maximum of sunshine. Concerning the therapeutic effects of diminished air pressure itself authorities differ, some holding it to be indifferent, others assigning it a positive value in dilating the air vesicles and increasing pulmonary circulation. Still others, while granting that many cases are benefited by such climates, believe that a rarefied atmosphere may be harmful in so far as the deeper breathing required is opposed to pulmonary rest and assists in breaking down existing consolidation. All agree that there is a large number of contraindications to high altitudes, and the following is a list of those for whom such a change is usually considered inadvisable: Those of low vitality and with poor circulation; the old or middle aged with declining powers of heat production; the erythric, neurotic individuals, or those with irritable temperaments; all with acutely progressing disease or those who can not attain even a temporary arrest in the home climate; very far advanced cases with much destruction of lung tissue, resulting in dyspnea (fibroid type included); those with dilatation or nervous derangement of the heart and certain forms of uncompensated valvular disease; and cases complicated with diabetes, nephritis, emphysema, dry catarrh, or much bronchial irritability.

For young adults without any of the foregoing complications who can and will secure proper medical attendance and submit to the same regimen that is necessary to effect a cure anywhere, the high, dry climate is the best. It has its dangers, one of which is the sense of well-being which may betray one into pernicious activity. It will frequently revive a jaded appetite or mitigate a troublesome moist catarrh at once, and it will add zest to life, but it will not insure recovery in every case and is not a short cut to health. Of the first 2,588 patients admitted to the Marine Hospital Sanatorium at Fort Stanton, N. Mex., 861 have died there, but a large number of these would not, in the light of present knowledge, be considered suitable cases for transfer, and, it may be added, that in the interest of the public health it is the policy of this institution to encourage hopeless cases to remain, unless the interests of the individual are best served by returning him to lower altitudes.

The following list of places with altitudes between 4,000 and 7,000 feet is believed to represent fairly well the high, dry climate, but is, of course, only suggestive of locations to be sought:

In Arizona, Flagstaff, Oracle, and Prescott;[1] in Colorado, Boulder,[1] Brush,[1] Canon City,[1] Colorado Springs,[1] Denver,[1] and Glenwood Springs; in New Mexico, Alamogordo,[1] Albuquerque,[1] East Las Vegas,[1] Las Vegas, Lincoln,[1] Santa Fe,[1] and Silver City;[1] in Texas, Alpine and Marfa; and in Wyoming, Cheyenne.

At moderate altitudes in the arid Southwest are many localities characterized by all the attributes of a dry climate. During the summer months these places are less comfortable than the more elevated ones just mentioned, but the winter nights are less severe at lower altitudes. Both are about equally subject to the dust storms of this region which occur occasionally, chiefly in March and April. The following places, all at altitudes between 2,000 and 4,315 feet, typify this climate: In Arizona, Castle Creek, and Tucson;[1] in New Mexico, Carlsbad, Deming, Las Cruces, and Roswell; in Texas, Boerne and El Paso.[1]

Warmer, less stimulating, more equable, and more humid, suited (especially as winter resorts) to those less robust and adapted to the needs of some for whom elevated regions are contraindicated, regions of less than 1,000 feet elevation, are exemplified in Aiken[1] and Camden, S. C.; Augusta and Thomasville, Ga.; Llano[1] and Columbus, Tex.

As typical of the warm, humid, equable climate should be mentioned Hawaii, certain parts of Florida, and the coast of southern California, and as winter resorts and for those with nephritis and

[1] Denotes location of private sanatoria.

advanced fibroid changes, as well as for the aged and cases complicated with excessive bronchial irritability, this type of climate is useful.

No consumptive should start for a health resort without first satisfying himself that he will be able to provide himself with suitable accommodations there. Certain places, notably in Texas, have been filled with indigent cases from the East who have severely taxed the patience and resources of the residents. Generalizations on climate are never of much value and each place must be judged by itself. The National Association for the Study and Prevention of Tuberculosis publishes a directory of institutions for tuberculosis in the United States and Canada, and its official organ, The Journal of the Outdoor Life, 2 Rector Street, New York, courteously states that its service department "will furnish, without charge, information about sanatoriums, boarding houses, health resorts, and such other data as it has on file."

PUBLICATIONS ON TUBERCULOSIS.

(Literature bearing upon tuberculosis issued by the United States Public Health Service. Most of the bulletins and reprints here listed may be obtained without charge by applying to the United States Public Health Service, Washington, D. C.; those publications marked "Exhausted," however, may be obtained only from the Superintendent of Documents, Washington, D. C., at the price specified.)

HYGIENIC LABORATORY BULLETINS.

57. I. The Presence of Tubercle Bacilli in the Circulating Blood in Clinical and Experimental Tuberculosis. By John F. Anderson. II. The Viability of the Tubercle Bacillus. By M. J. Rosenau. September, 1909. Exhausted. 5 cents.

99. The Friedmann Treatment for Tuberculosis: A report of the board appointed for its investigation. By John F. Anderson and Arthur M. Stimson. October, 1914. Exhausted. 10 cents.

101 I. Complement Fixation in Tuberculosis. By A. M. Stimson. (Other papers in this bulletin not on tuberculosis.)

PUBLIC HEALTH BULLETINS.

36. Tuberculosis: Its Nature and Prevention. By F. C. Smith. 1910.

53. Studies of Plague and Tuberculosis Among Rodents in California. VI. A note on the susceptibility of ground squirrels (*Citellus Beecheyi*, Richardson) to tuberculosis. By George W. McCoy and Charles W. Chapin. January, 1912. Exhausted. 5 cents.

58. Open-Air Schools for the Cure and Prevention of Tuberculosis among Children. By B. S. Warren. October, 1912. Exhausted. 15 cents.

60. Rules to be Observed by Tuberculous Patients. By F. C. Smith. January, 1913. Exhausted. 5 cents.

73. Tuberculosis Among Industrial Workers: Report of an investigation made in Cincinnati, with special reference to predisposing causes. By D. E. Robinson and J. G. Wilson. March, 1916.

REPRINTS FROM THE PUBLIC HEALTH REPORTS.

39. A Working Plan for Colored Antituberculosis Leagues. By C. P. Wertenbaker. September, 3, 1909. Exhausted. 5 cents.
51. Pulmonary Hemorrhage in the Tuberculous at High Altitude (6,200 feet); Report of 56 Deaths; Frequency of Associated Heart Disease. By F. C. Smith. October 7, 1910. Exhausted. 5 cents.
125. The Friedmann Treatment for Tuberculosis: A report on the present status of its investigation by a board of officers of the Public Health Service. May 16, 1913.
145. Tuberculosis Sanatorium, Fort Stanton, N. Mex.: A report for the year ended June 30, 1913, of the sanatorium maintained by the Public Health Service for the treatment of tuberculous patients. By F. C. Smith. October 17, 1913.
158. Tuberculosis in Switzerland: Results of the campaign against the disease. By W. C. Rucker and R. A. Kearny. December 28, 1913.
216. Tuberculosis Sanatorium, Fort Stanton, N. Mex.: A report for the year ended June 30, 1914, of the sanatorium maintained by the Public Health Service for the treatment of tuberculous patients. By F. C. Smith. August 28, 1914.
221. Tuberculosis: The financial aspect of the sick leaving home in search of a beneficial climate. By Thompson Frazier. September 18, 1914.
243. The Tuberculosis Problem in Rural Communities: Its modern aspect and the duty of health officers. By A. Adolphus Knopf. December 18, 1914. Exhausted. 5 cents.
249. The Spread of Tuberculosis: Report on the spread of infection in certain tuberculous families in five counties in Minnesota. H. G. Lampson. January 8, 1915. Exhausted. 5 cents.
265. Interstate Migration of Tuberculous Persons: Its bearing on the public health, with special reference to the States of North and South Carolina. By A. D. Foster, March 12, 1915.
266. Interstate Migration of Tuberculous Persons: Its bearing on the public health, with reference to the State of California. By P. M. Carrington. March 19, 1915.
269. Interstate Migration of Tuberculous Persons: Its bearing on the public health, with special reference to the States of Texas and New Mexico. By Ernest A. Sweet. April 9, 16, and 23, 1915.
282. Tuberculosis: The municipal care and supervision of the tuberculous. June 18, 1915.
283. Interstate Migration of Tuberculous Persons: Its bearing on the public health, with special reference to the States of Arizona and Colorado. By A. J. Lanza. June 18, 1915.
309. Tuberculosis, with special reference to its epidemiology, transmissibility and prevention. By George M. Kober. October 29, 1915.

SUPPLEMENTS TO THE PUBLIC HEALTH REPORTS.

3. Tuberculosis: Its predisposing causes. By F. C. Smith. February 7, 1913.
26. Public Health Administration in Richmond, Ind. A report of a survey to determine the incidence of tuberculosis. By J. C. Perry. October 8, 1915.

RELATED PUBLICATIONS.

(As the prevention of tuberculosis depends so much on personal hygiene a number of more general publications are given herewith. These may be obtained without charge by applying to the United States Public Health Service, Washington, D. C.)

PUBLIC HEALTH BULLETINS.

69. Typhoid Fever: Its Causation and Prevention. By L. L. Lumsden. May, 1915.
76. Health Insurance: Its Relation to the Public Health. By B. S. Warren and Edgar Sydenstricker. March, 1916.
78. Influence of Occupation on Health During Adolescence. Report of a physical examination of 679 female minors under 18 in the cotton industries of Massachusetts.

REPRINTS FROM PUBLIC HEALTH REPORTS.

100. Whooping Cough—Its Nature and Prevention: A popular discussion of a widespread and dangerous disease for which familiarity has bred contempt. By W. C. Rucker. October, 25, 1912.
116. Country Schools and Rural Sanitation. Six sample public schools in one county. Does this county need medical inspection in its schools? The country schoolteacher. By Ch. Wardell Stiles. February 7, 1913.
150. The Citizen and the Public Health: The individual's relation to the health of the community. By John W. Trask. November 7, 1913.
195. Industrial Conditions: Their Relation to the Public Health. By B. S. Warren. May 29, 1914.
197. Industrial Insurance: Medical examination of employees and prevention of sickness its proper foundation. By J. W. Schereschewsky. June 5, 1914.
234. Physical Examination of Workers. By J. W. Schereschewsky. November 20, 1914.
250. Sickness Insurance: Its relation to public health and the common welfare. By B. S. Warren. January 8, 1915.
287. The Practical Use of Disinfectants. By H. E. Hasseltine. July 2, 1915.
306. Lung Capacity of Children: Spirometer tests of 1,618 white school children (751 boys; 867 girls) in the city of X. By C. W. Stiles and Floyd Graves. October 15, 1915.

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2. Indoor Tropics: The injurious effect of overheated dwellings, schools, etc. By J. M. Eager. January 31, 1913.
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